Blended Learning in Practice

Autumn 2021

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Editorial

Welcome to the Autumn 2021 edition of our e-journal Blended Learning in Practice. In this edition we have four research articles from participants on the Post Graduate Certificate in Learning and Teaching in Higher Education (PGCertHE) programme at the University of Hertfordshire. Additionally, we have an article submitted by colleagues in the School of Physics, Engineering and Computer Science.

In this edition:

Kalpana Shukla analyses the methodology of Critical Incident Theory as a means of bringing its benefits for learners and organisations into sharp focus. The article examines scenarios where Critical Incident Theory has been used with positive impact and where the results have provided areas for focus and improvement. It is anticipated that the article will provide a sense purpose in creating narratives for learners, not only for the Senior Leader Degree Apprenticeship Programme but allow learners to rationalise and contextualise their experiences in the workplace for their organisations.

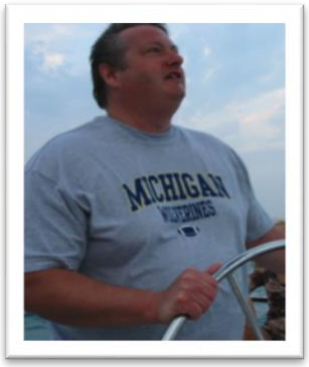
Matthew Tidmarsh's article utilises Paulo Freire's *Pedagogy of the Oppressed* to accentuate the transformative potential of teaching and learning practices within Criminology. It applies his writings to the literature on 'public criminology' - a perspective that aims to render the field more transparent, applied, evidence-based, empowering, and committed to social justice - focusing on how criminology students can be *empowered*. Drawing from personal reflections on his role as a Lecturer in Criminology at the University of Hertfordshire, the article advocates for a 'pedagogy of public criminology' that equips students, as future criminal justice professionals, with the skills to be public-facing, active, and critical subjects who can make a difference in the lives of offenders.

Paul Moggridge presents some findings on improving engagement with recorded lectures by editing the videos and adding gamification. Formative quizzes were appended into the existing videos. Two approaches were trialled, one directed students to a quiz after watching the video, the other asked the students to create quiz questions during the video. Paul discusses how these changes impacted on engagement and the lessons learnt from the study.

Muhammad Jamroa, Scarlett Xiaoa, Angus Hutton-Mckenziea and Amanda Yip present the framework design and structure of a day-release type 'Mini-Projects' using active learning fundamentals, employing a hybrid combination of Problem-based Learning and Tasks-based Learning with some flavour of Flipped learning. It stimulates and motivates students to apply their knowledge, skills and abilities solving a given problem without a lab-script overcoming project dilemma. The study includes student's satisfaction survey analysis confirming successful delivery to various programmes of studies in the School of Physics, Engineering and Computer Science at University of Hertfordshire. Various recommendations

are made in this study suggesting the possible adaptation of Mini-Projects activities for use across a range of applications.

Timothy Carew explores the transition of Level 4 Engineering students into higher education at the University of Hertfordshire and the role of the personal tutor in simplifying this process. Timothy proposes that giving students agency to interact with their peers, challenge assumptions and conduct sense-making early within their academic careers would help facilitate their transition into higher education. He argues that the nature of a personal tutor group provides a convenient environment in which to promote empathetic engagement and to develop self-understanding amongst first-year engineers through problem-based activities. The paradigm of 'inclusive design practice' is proposed as a useful framework in which to conduct this work and to promote compassion-focussed pedagogy within the engineering curriculum.



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Kalpana Shukla is a Lecturer in Strategy and a Programme Leader at the Hertfordshire Business School. Having spent time in Quality (Manufacturing) and Financial Services. She Joined the Business School in 2018. Kalpana's own experiences have made her passionate about supporting learners on the challenges of combining work and study. Kalpana brings a wealth of knowledge and industry experience to the Senior Leader Programmes at HBS.

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Paul Moggridge is a Lecturer in Data Science and Software Development, and is studying for a PhD researching unsupervised learning. He strives to create robust methods for recognising groups in data through by creating novel clustering algorithms which apply weights to rows of data. Before joining the University in 2020 as a full-time Lecturer, Paul worked on a Knowledge Transfer Partnership project as a Data Mining and Machine Learning Project Manager.

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Timothy Carew is a Senior Lecturer in Automotive Engineering at the University of Hertfordshire. Prior to joining the University in 2020, Tim worked for 8 years as an Aerodynamicist in Formula One where he specialised in wind tunnel testing and computational fluid dynamics simulations. A Chartered Engineer, Tim is currently studying for his PhD at the University of Cambridge. Tim is particularly interested in how 'inclusive design practice' can promote compassion-focussed pedagogy within the engineering curriculum.

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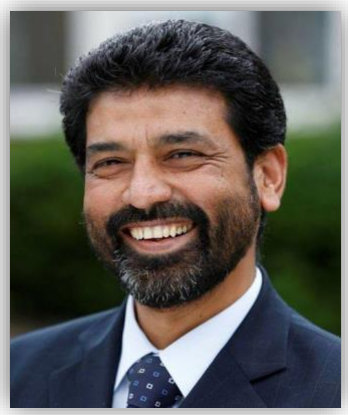

Muhammad Jamro is a Senior Lecturer in School of Physics, Engineering and Computer Science. He has a PhD Manchester Metropolitan University and joined the University of Hertfordshire in 2001. Amongst his many roles, he is the University liaison officer to the IEEE. Muhammad's main research interests are in hybrid Li-Fi/Wi-Fi, optical and wireless enabling technologies, environmental engineering, and learning and teaching technologies. He is a CEng, Senior member of the IEEE, Practitioner member IEMA, member IET and an FHEA.

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Scarlett is an Associate Professor at the University of Hertfordshire, she is also a Senior Fellow of the HEA. She has been awarded a number of national learning and teaching grants funded by the Royal Academy of Engineering, JISC and the Higher Education Academy. In recognition of her track record and active contributions in engineering education, Scarlett has been awarded a Highly Commended in the Vice-Chancellor's Award for enhancing the quality of the student experience. Scarlett enjoys teaching and continues to demonstrate her motivation and professionalism through her practice.

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Angus Hutton-McKenzie is a Senior Lecturer in the School of Physics, Engineering and Computer Science. Angus has led many Enterprise-led R&D projects. He is an expert in understanding the needs of industry and developing and consulting on technological solutions to those challenges, in the areas of electronics design, rapid prototyping, embedded software, Software development for Microsoft environments and 'Internet of Things'. He is the School's Academic Commercial Lead for Engineering. Angus is also an Associate Fellow of the HEA, with an interest in student experience and modern pedagogical and andragogical practices.

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Matt Tidmarsh is a Lecturer in Criminal Justice at the University of Leeds. He completed his PhD at the School of Law, University of Leeds, in November 2019 – just after taking up a lectureship at the University of Hertfordshire in August 2019. He re-joined the University of Leeds in August 2021. Matt's research interests traverse criminology, sociology, and social policy, with a current interest in the Probation Service in England and Wales. His first monograph, *Professionalism in Probation: Making Sense of Marketisation*, was published in August 2021 by Routledge Press.

Are there any benefits in using the Critical Incident Technique (CIT) for Senior Leader Degree Apprentices on a level 7 Executive Programme at the Hertfordshire Business School?

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Abstract

Many of the learners on the Senior Leader Degree Apprenticeship (SLMDA) programme at the Hertfordshire Business School are front line emergency services staff and are currently working in increasingly challenging environments to manage the COVID-19 pandemic. This has required learners to 'step out of their comfort zone' from what has been their normal activities and duties.

An essential part of the SLMDA is the submission of a portfolio of reflective narratives that meet the requirements that are mapped to a predefined set of 'standards'. This paper aims to provide learners with an approach that has the potential to enrich their written narratives and that can enable them to face the challenges in their places or work. Especially during the current pandemic when many learners have found it challenging to allocate time and head space to activities outside of their work such as reflective writing.

This paper analyses the methodology of Critical Incident Theory (CIT) by Flanagan, J. (1954) as a means of bringing the benefits for learners and organisations to the forefront.

This paper examines scenarios where CIT has been used with positive impact and where the results have provided areas for focus and improvement.

It is anticipated that this paper will provide a sense purpose in writing narratives for the learners not only for the SLMDA programme but allow learners to rationalise and contextualise their experiences in the workplace for their organisations.

Purpose statement

In line with the University of Hertfordshire's Strategic Plan (2020 to 2025) to 'transform lives' (2021a), learners on the SLMDA programme are on an upward trajectory to becoming Senior Leaders, can we actually help them process and work through the many challenges that they have faced during the current COVID-19 pandemic? The aim of this paper is to provide learners at the Hertfordshire Business School (HBS) to not only meet the requirements of the SLMDA programme in the form of reflective written narratives but, also

to provide a methodical approach to incidents in the work place and that can empower them to meet the challenges of the Covid pandemic and beyond.

Introduction

This paper focusses on the Critical Incident Technique (CIT) that was first conceptualised by Flanagan (1954) as a methodology for learners to reflect on the challenges that they have faced and continue to manage in their places of work as we work through this pandemic.

It is important here to point out that CIT discussed in this paper is not to be confused with other similar sounding theories such as the Critical Incident Analysis by Tripp (1993) that is a pedagogical theory for allowing reflection in the teaching environments. Beigi (2016) asserts that the Critical Incident Analysis by Tripp (1993) is a tool to examine teaching practices and that it aims to identify the root as to why a particular teaching session has triggered strong thoughts, leading the teacher to look back on it and explore options for the future. Although the Critical Incident Technique by Flanagan (1954) and the Critical Incident Analysis by Tripp (1993) sound similar) simply from their names, they are different. The aim of this paper is not to further explore teaching environments therefore, Critical Incident Analysis by Tripp (1993) will not be discussed in this paper. This paper will also not discuss the work of Stephen Brookfield (1998) in the area of Critical Reflection where educators can examine their practice and seek to explore the assumptions that form how they approach their work. In this paper, it is anticipated that SLMDA learners are provided with a tool that allows them to tackle specific challenges in their places of work and this is why the Critical Incident Technique by Flanagan (1954) is being discussed here in this paper as a suitable tool specifically for this.

A short explanation on the requirements from learners on the SLMDA programme is included to provide context for CIT and this leads into examples and situations where it can be potentially used by learners. A set of common steps in CIT is presented and linkages for its usefulness are discussed.

Finally, it is hoped that CIT can be included on the curriculum for the development and enrichment of reflective writing on Degree Apprenticeship programmes and be adopted by learners for analysing incidents and events in their professions. Furthermore, it is anticipated that the reflection required from learners on the programme can help them to personally process the many new tasks and changes that have been implemented in their places of employment and in their normal work arrangements during this time.

Literature Review

What is the Critical Incident Technique?

The Critical Incident Technique (CIT) was first conceptualised by Flanagan (1954) who described it as a set of procedures for collecting qualitative data on human behaviour in a

manner that processes it in terms of its prospective usefulness in solving problems. This technique is still used today (Butterfield et al., 2005). Furthermore, it is used in career development (Dix and Savikas, 1995), counselling psychology (Woolsey, 1986), teaching (Raedmacher, et al, 2010) and nursing (Kempainnen, 2000).

In its origins, it started as a methodology for gathering and facilitating the investigation of important facts on events, incidents, processes, or issues (Akinci, 2014). Since then, it has evolved from direct observation to retrospective self-report, from tasked based analysis to psychological focus. CIT's creation came about from the studies carried out in the Aviation Psychology Program in the United States during World War II. A first study focussed on the reasons provided for failure in learning to fly by one thousand pilot candidates excluded from flight training during Autumn 1941. The proceedings from the elimination boards formed the source of the analysis. Reasons for failures given by instructors and check pilots included 'lack inherent flying ability' and vague summations such as 'unsuitable temperament'.

Although this information was useful in providing information on the selecting of pilots, it did not provide specific enough information on pilot performance. Several subsequent studies highlighted the need for more factual information on specific incidents so that 'critical requirements' could be formulated and implemented towards better planning. For example, in a project involving the collection of specific experiences of pilots when taking off, using instruments, landing, and using controls by the US Aviation Psychology Program in 1946, resulted in developments for the designing of instruments and controls and the layout of these within the cockpit (Flanagan, 1954).

Developments in the technique since its origins

Since its early origins, CIT has evolved so that its results have come to have credibility. It has evolved from direct observation to reflective reporting, from task focus to psychological perspectives (Akinci, 2014) and has been used across a wide range of disciplines such as nursing, education, and teaching. However, it is in its application in investigating effective and ineffective practices in organisations, a focus on helpful and impeding factors and the collating of functional or behavioural accounts of events or issues, looking deeper into the successes and failures or even determining aspects that are fundamental to a particular event or activity (Akinci, 2014) that will be the basis of this paper.

The CIT Approach in steps

There are five common steps involved in any CIT study as follows (Viergever, 2019):

Step One is to describe the main activity.

Step Two asks for plans and specifications to be made, this includes a definition of the critical incident, its significance and extent of impact on the aim and the characteristics of participants.

Step Three involves the collection of data from participants on what they believe to be the factors, events, behaviours, or experiences that are helpful and impeding to the experience with reasons.

Step Four is the analysis of the data from Step Three by categorising critical incidents into areas and sub areas that can have practical uses for the rationale of the study.

Finally, **Step Five** is the interpretation and communication of the results where shortcomings and biases are put forward.

Findings- Examples of CIT in practice

A study by Petola et al. (2018) within health studies investigated the professional – patient communications that have aided or hindered patient self-management for those with chronic illnesses. Finnish patients with Type-2 Diabetes were participants in an open e-survey and semi-structured interviews. The data was analysed for themes using a qualitative method for content analysis. The findings revealed both positive and negative accounts that were linked to four many-sided characteristics: creation of trust in the professional-patient relationship, readiness to communicate, sensitivity, and suitability. This example supports findings by Kemppainen (2000) at that time, where it was outlined that the studies into health care quality using CIT 'are just beginning'. Furthermore, in agreement with this study, a framework can be formed from the four characteristics that can lead to the betterment of care communications with patients.

An application in medical education research by Cardiff University utilises CIT in a short guide for researchers (Cardiff University, 2019) and references a worked example within paediatric dentistry (FitzGerald et al., 2008). In this example, the steps as described by Viegever (2019) will be used and explained below.

Step One is to describe the main activity: an investigation into the clinical segment of the curriculum from the student perspective at Baylot College of Dentistry.

Step Two asks for plans and specifications to be made, this includes a definition of the critical incident, its significance and extent of impact on the aim and the characteristics of participants: all 173 third- and fourth-year students invited to participate in semi structured interviews by the researcher (K. FitzGerald). The study is approved by the Institutional Review Board of the College.

Step Three involves the collection of data from participants on what they believe to be the factors, events, behaviours, or experiences that are helpful and impeding to the experience with reasons: most participants give two interviews – providing information on one positive

and one negative experience when giving care to paediatric patients with the freedom to describe more experiences if they wanted. (Note: the researcher summarised every incident before the next step)

Step Four is the analysis of the data from Step three by categorising critical incidents into areas and sub areas that can have practical uses for the rationale of the study: positive and negative experiences analysed separately, and then similar incidents grouped together until all have been categorised. Simple frequency analysis performed that makes up 'sub-categories' and leads to the creation of two 'mind maps' (MindTools, 2021).

Finally **Step Five** is the interpretation and communication of the results where shortcomings and biases are put forward. Four key factors are revealed from the analyses: the instructor, the patient, the learning process, and the learning environment.

It can be seen from this worked example that CIT can be a highly effective where useful deductions for areas of focus and improvement can be identified.

More recently, a study is proposed by East Midlands Policing Academic Collaboration (EMPAC) (EMPAC, 2020) consisting of five forces, Police Offices and Crime Commissioners with University researchers where CIT is to be used to look into the effects of the COVID-19 pandemic on policing. It is intended that a large proportion of frontline officers in a specific police area impacted by COVID-19 would be contacted (anonymously) through telephone interviews. As mentioned by Paul Murray and John Lauerman, (2020), events such as COVID-19 are rare and thus, providing very few opportunities to investigate police behaviour. Participants would be asked to describe two incidents during the lockdown period (source is dated June 2020, so it is assumed that the first lockdown period is being referred to): an incident that they found difficult and another that they found fulfilling. It is anticipated that the proposed research will provide valuable input for police education and training. This specific example may appeal to apprentices currently working within the policing services.

Background to the Senior Leader Degree Apprenticeship Programme requirements

An integral part of the successful completion of an SLMDA programme at Level 7 is for learners to develop professionally as Senior Leaders (CMI, 2021). Essentially, in addition to the successful completion of an academic level 7 Master's programme, learners are required to have an end point assessment (EPA). This includes a project showcase on a work-based project, a written report, presentation, and a professional discussion with questioning from a third-party assessor (CMI are HBS' appointed assessor) that is based on a review of a portfolio of evidence (supported with narratives) that has been carefully prepared by the Apprentice throughout the duration of the programme. Learners must demonstrate learning in the three key areas of Knowledge, Skills and Behaviours (CMI, 2021) against a set of criteria in the standard as defined by the CMI.

Current tools and techniques available to learners

Although there is virtually free reign when writing narratives, during the Degree Apprenticeship workshops, learners have been introduced to three models that can be used to assist with the structuring and reflection of narratives. Some of the current models and frameworks to aid the development of reflective practice that have been introduced to learners include Rolfe reflective framework (Rolfe, 2001, cited in Rolfe et al. 2011), a focus on reflection-on-action by Schon (1983) and a 'reflective diary tool – flow chart' by Chapman et al. (2006). At this juncture, it is important to point out the distinction between these and CIT. Whilst the models and frameworks above can be valuable aids in guiding learners through a process of reflection towards written forms of iterative pieces of narratives, CIT on the other hand is a methodology as Bradley (1992) succinctly puts it as 'turning anecdotes into data' in his guidance article studying quandaries in medicine.

The Senior Leader Degree Apprenticeship's potential to utilise CIT

It is in the preparation of these iterative pieces of written narratives that CIT could potentially assist in the adopting of a reflective practice that could lead to the enrichment of narratives and aid the processing of experiences for learners. This has the potential to benefit the learner's organisation too. Especially, during the challenges that many learners have faced in their workplaces during the current COVID-19 global pandemic. Since CIT's early beginnings it has evolved and has spread to nursing and healthcare and in particular, patient safety (Steven et al., 2020). In support of the work by Steven et al. (2020), the Royal College of Nursing (RCN, 2020) has published an article during the pandemic on the importance for nursing staff to report incidents and concerns and the need to do this through an organisation's proper channels. Furthermore, the article continues to encourage nursing staff to raise concerns so they can be addressed and acted on. If management are unaware of the problems, then change cannot happen. It is in these instances that safety is potentially at risk.

Perhaps one of the most poignant examples of this was the low availability of Personal Protective Equipment (PPE) when the pandemic crisis took hold (BBC, 2020). Renewed concerns around supplies of PPE are continuing with the threat of a 'new, more contagious variant' of the Covid virus already in the UK (BBC, 2021). Here, CIT can potentially be utilised with specific incidents during the pandemic. Learners on the Degree Apprenticeship programme have the opportunity to potentially bring to the forefront an 'incident' where they could use CIT to solve a problem. This could then be written as part of a narrative for their portfolio. The organisation can also reap the benefits of having confidence of a methodical approach being taken to solving a given problem.

Potential to include CIT in the SLMDA Curriculum

All three of the Senior Leadership Degree Apprenticeship programmes at the Hertfordshire Business School: Master Business Administration (MBA), Master of Business and Organisational Strategy (MBOS) and Public Sector Management (PSM) consist of six workshops across their duration. These workshops are designed to support learners by providing them with the necessary tools, techniques, and methods to write reflective narratives and aid the completion of their e-portfolio for assessment on the apprenticeship part of their SLMDA programme of study. It was observed by Module Leaders on the SLMDA programme that the pandemic evoked unexpected challenges for learners on the Degree Apprenticeship programmes both professionally and personally, since lockdown was announced by the UK Government in March 2020 (IFG, 2021).

Whilst Module Leaders for the Apprenticeship modules do closely follow the already set curriculum, there has been an understanding that it has been necessary to adapt and modify the content depending on which month and year cohorts started their Degree Aprrenticeship journey. Although, there can be no guarantee that the Critical Incident Technique by Flanagan (1954) will be part of the curriculum at the time of writing this paper, it can easily be part of the content on the workshops for learners to consider using due to the flexibility of content during workshop planning. However, although the current SLMDA programmes are ceasing to continue after this academic year (2021 to 2022), the Critical Incident Technique (Flanagan, 1954) can easily form part of the curriculum content for the new Senior Leader Higher Apprenticeship that is now being offered at the Hertfordshire Business School (University of Hertfordshire, 2021b).

Examining the limitations of CIT and balancing these with reasons to support learners who wish to use CIT

Table 1 shows some of the limitations of CIT. Each of these limitations will be taken in turn and discussed in terms of their shortcomings for learners on SLMDA programmes at HBS. The table is by no means an exhaustive list.

Table 1

Limitation or issue linked to the Degree Apprenticeship Learner or organisation	Possible remedy or solution
Flawed recall by respondents (Akinci, 2014)	Material needs to be validated (Akinci, 2014)
Skill of the interviewer	Skilled and mature researcher needed (Cassell and Symon, 2004)
No standard approach to ensure credibility of results (Akinci (2014)	Inter-rater reliability, triangulation (Akinci, 2014), examining of categories by experts Ellinger and Bostrom (2002)
Finding the time during the COVID pandemic	Evaluate the 'return on investment'
For CIT to 'work'	Recognition and ownership

A criticism of CIT is that it relies heavily on the recall ability of respondents. This invariably compromises the accuracy and truthfulness on the reporting of incidents. Additionally, this allows for biases to creep in which can lead to inferences being made on distorted data (Akinci, 2014). A solution could potentially be to validate the data. Whilst this seems like a simple remedy, the validation must be done such that it remains unknown to the respondent and that it does not undermine their integrity.

According to Cassell and Symon (2004), skill and the ability of a 'mature' researcher is required as they outline CIT interviews are not easy to conduct as interviewers need to be able to direct the interview to attain clarity and understanding of the responses given. Researchers also need to manage emotions such as distress. In disagreement with this, many of the learners are front line workers whose role is to deal with people on a daily basis. Thus, they are already well equipped with the necessary skills for managing a range of emotions. Thus, for these learners, the area of focus should be concentrated on steering the interviews towards meaningful data for useful CIT analysis to take place.

Akinci (2014) asserts a lack of literature available on the credibility or trustworthiness of the results. This has led to many unrelated methods being adopted such as Inter-rater reliability, triangulation (Akinci, 2014) and examining of categories by experts as used successfully by Ellinger and Bostrom (2002) in their study on managerial beliefs as they facilitated learning events. The first two methods require time on the part of the researcher and the third would mean the engaging of an additional resource who is familiar with CIT and the study who is able to devote their time. Thus, these are areas to consider when designing a CIT study.

Understandably and as mentioned earlier, many of the learners on the apprenticeship programmes are also in full-time roles whilst managing other commitments outside of work and learning. This balance of responsibilities has been further compounded with the impact of the COVID-19 pandemic. Consequently, learners would inevitably question whether the benefits outweigh the commitment of time for embarking on a CIT study. Thus, it is important that learners are made aware that there are several gains for this. Firstly, it has the potential to enhance and enrich a narrative for their portfolio for the apprenticeship programme. Secondly, as mentioned by Steven et al. (2020), its uses have expanded to nursing and healthcare and in particular, patient safety. The example in Petola et al. (2018) that looked at patient communication for those with chronic illnesses and the proposition by EMPAC to examine the impact of the COVID-19 pandemic on policing should help learners to consider using CIT as a tool to understand key requirements of individuals, processes and systems in their places of work (Rosala, 2020) and see the return on time invested.

This leads to another potential limitation where learners could potentially encounter a lack of recognising that an issue actually exists coupled with a lack of ownership. Similarly, this could have the added consequence for the issue to not be taken seriously. In such situations, learners may experience push back and it will require skills of bringing the issue to the forefront of stakeholders and its impact should a CIT study not be chosen as a tool to resolve the issue to a satisfactory outcome.

Conclusion

In conclusion, this paper set out to investigate if there were any benefits in using CIT for Senior Leader Degree Apprentices at HBS. CIT was described from its early origins in the work of Flanagan (1954) to five common steps as outlined by Viergever (2019). This was then followed by examples of CIT in practice in the areas of health studies and medical education research and a potential study looking into the effects of the COVID-19 pandemic. These examples demonstrated positive scenarios that hopefully place confidence in CIT. This then led onto providing some background on the requirements of the SLMDA programme at HBS. Some of the current tools available to learners when writing narratives were mentioned and briefly described.

It is at this juncture that it was explained that CIT can be used to enrich narratives and help with the processing of experiences with learners. Especially, during the challenging times that the pandemic has presented. Although there are limitations for CIT such as flawed recall by respondents, the skill of the interviewer and the lack of a standardised approach for credibility of the results, there was an important need to select and contextualise these for the learners and additionally for the current challenging times with the pandemic. Thus, another limitation of allowing time to apply CIT was explained in terms of the 'return on investment' should learners wish to use CIT.

It is hoped that learners can see tangible benefits of using CIT for their reflective work on the apprenticeship programmes at HBS and the positive impact it can have in their work situations. It is anticipated that this paper can be added to the HBS' Apprenticeship module sites on Canvas (University of Hertfordshire's online learning platform) for their current SLMDA programmes: Master of Business Administration (MBA), Master of Business and Organisational Strategy (MBOS) and Public Sector Management (PSM). From current experience and interactions with learners, the module delivery team anticipate that learners' will consider using CIT when they come to understand the potentially positive outcomes that can be achieved in their places of work.

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Towards a pedagogy of 'public criminology': Lessons from the Pedagogy of the Oppressed

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Abstract

As a subject of study in higher education, criminology has never been more popular; and yet, criminologists occupy an increasingly marginal position within political and media spheres. This marginalisation has been to the particular detriment of offenders, an oppressed class whose number has grown exponentially after several decades of a 'tough on crime' consensus on criminality. This article utilises Paulo Freire's *Pedagogy of the Oppressed* to accentuate the transformative potential of teaching and learning practices within criminology. It applies his writings to the literature on 'public criminology' - a perspective that aims to render the field more transparent, applied, evidence-based, empowering, and committed to social justice - focusing, in particular, on how criminology students can be *empowered*. Drawing from personal reflections on my role as a Lecturer in Criminology at the University of Hertfordshire, the article advocates for a 'pedagogy of public criminology' that equips students, as future criminal justice professionals, with the skills to be public-facing, active, and critical subjects who can make a difference in the lives of offenders.

Introduction

Paulo Freire's (1970/2014) Pedagogy of the Oppressed has proved a hugely important text for the development of teaching and learning practices in higher education (Ludlow et al., 2019). His criticism of the 'banking model' of learning, of the 'fundamentally narrative character' (Freire, 1970/2004: 140; emphasis in original) of the teacher-student relationship, has been particularly influential. This 'humanist' model of education assumes that knowledge is an unqualified 'good'; a gift bequeathed by teachers to students, who are presented as 'containers' to be 'filled'. The 'educator's role is to regulate the way the world "enters into" students' (Freire, 1970/2004: 151), thereby sustaining a system of oppression. To counter the banking model, Freire (1970/2004) called for a dialogic approach in which teachers become students and students become teachers. Trusting in the oppressed as people who also 'know things' (Freire, 1970/2004: 122) could produce meaningful transformation. Such change, he argued, would result from praxis, or reflection and action, which would in turn contribute to a 'pedagogy of all the people' (Freire, 1970/2004: 103).

Here, it is important to note that Freire's (2017) ideas were forged in the radicalism of South American class politics in the 1960s. His observations on the 'oppressed' (and, by extension, the identity of the 'oppressors') are not directly transferable to contemporary teaching and learning in higher education. For a field of study such as criminology, however, it is possible to identify an 'oppressed' class – that is, the offenders whose lives are transformed by the harms perpetuated by the criminal justice system (McNeill, 2019). Recently, scholars have highlighted how the lack of influence of criminologists within policy-making spheres has contributed to such oppression (Uggen & Inderbitzen, 2010). There is chasm between the (rehabilitative) policies and programmes advocated by most criminologists and the (punitive) reality of criminal justice systems, particularly in the UK and the USA (Currie, 2007). The marginalisation of criminologists is in spite of the popularity of criminology as a subject of study: an increasing number of young people are drawn onto university courses through media representations of crime and criminality, such as television programmes and podcasts (Uggen & Inderbitzen, 2010). Indeed, the demand for such courses has arguably been driven by a failure to challenge distorted media portrayals of crime (Dearey et al., 2011; Crepault, 2017).

This paper, therefore, takes inspiration from Freire's (1970/2014) work as a means to empower criminology students with the tools to counter dominant narratives on crime and to work towards positive penal transformation. Students are presented not as passive learners to be 'domesticated' (Freire, 1970/2004) into the inevitabilities of retributive criminal justice systems, but as key interlocuters in the relationship between (marginalised) criminologists and an oppressed class of offenders. Here, the paper draws upon and develops a nascent literature on the 'pedagogy of public criminology' (Hamilton, 2013). The study of 'public criminology', defined by Currie (2007: 176) as 'one that takes as part of its defining mission a more vigorous, systematic and effective intervention in the world of social policy', has emerged in recent decades in an attempt to overpass this divide between public perceptions of crime and professional inertia. Scholars who advocate for more and more diverse engagement with different 'publics' have typically focused their attention on 'news making' organisations (Groombridge, 2007), policy-makers (Currie, 2007), and the (marginalised) individuals and communities at the sharp end of criminal justice policy (Carrabine et al., 2000). One 'public', however, is notable for their relative absence: students (Uggen & Inderbitzen, 2010). A commitment to empowering students is thus integral to a pedagogy of public criminology (Hamilton, 2013).

The first part of the paper briefly draws out the meaning of a public criminology and emerging attempts to apply it to pedagogic practices (e.g., Hamilton, 2013). The second part draws reflexively from my experiences as a Lecturer in Criminology at the University of Hertfordshire to develop a pedagogy of public criminology. Like Freire's (1970/2014) Pedagogy of the Oppressed, it foregrounds the transformative potential of education – not only for students, but also for those oppressed by the criminal justice system. The paper

concludes that the development of a pedagogy of public criminology provides a means to simultaneously empower marginalised communities and to reinvigorate the field.

Public criminology' and its contributions to pedagogy

Uggen and Inderbitzen (2010) note that the public think about crime (and criminology) differently from other social phenomena. The problem of crime, they argue, stimulates both general anxieties and distinct concerns about particular groups or acts, which means that it holds emotive sway over the public imaginary – a sensibility that criminologists, armed with dispassionate peer-reviewed evidence in academic journals, have found increasingly difficult to influence. These 'moral panics' (Cohen, 2002) have been mobilised by politicians and policy-makers as viable electoral strategies in recent decades (Downes & Morgan, 2007, 2012). This 'populist punitiveness' (Bottoms, 1995) has contributed to the rise of 'mass imprisonment' (Garland, 2001) and its concomitant harms on individuals, families, and communities (Wacquant, 2009; Bell, 2011; McNeill, 2019). And yet, seismic changes to criminal justice systems, in the UK but particularly in the US, have occurred against the backdrop of falling crime rates over the same period (Blumstein & Wallman, 2010; van Dijk et al., 2012). As a result, the purposes and practices of crime control idealised by most criminologists look markedly different from the reality (Currie, 2007). Such divergence, scholars have observed, points to the increasingly marginal status of the field of criminology (Currie, 2007; Piche, 2015).

Crepault (2017) highlights both internal and external explanations for the marginality of criminology as a field capable of influencing policymakers and public opinion. Externally, where mainstream criminology largely attributes criminality to societal and environmental factors and advocates for rehabilitative approaches, it is typically presented within political and media spheres as the product of individual failings (Garland & Sparks, 2000). That crime and criminal justice are areas of social life which are not confined to experts means everybody can have an opinion (Groombridge, 2007; DioGuardi, 2017). Indeed, it is these 'popular' opinions, augmented in recent years by public appetite for 'true crime' podcasts and documentaries (Dearey et al., 2011), which have a greater impact on the public consciousness than so-called 'academic criminology' (Rawlings, 1998). Internally, this distance between criminologists and the public has been exacerbated by the confinement of academic debate to small circles hidden behind the paywalls of journals (Crepault, 2017).

Neoliberal universities, particularly those with a research focus, privilege this 'original' research over other forms of engagement (Currie, 2007). This 'hierarchy of credibility' (Morgan, 1999: 330) affords greater epistemic value to professional criminologists at the expense of the 'ordinary' knowledge possessed by those with lived experience of the criminal justice system (Dearey et al., 2011). In Freire's (1970/2014: 109) terms, the university has hardened 'into a dominating "bureaucracy"', within which there is little room to widen audiences and deepen their understandings. Accordingly, criminologists have

become increasingly detached not only from popular discourses on crime, but also from 'the thrust of social policy' (Currie, 2007: 176).

In an era of 24/7, news coverage, one in which time to reflect on issues has arguably been devalued (Rowe, 2012), the 'real experts' (Uggen & Inderbitzen, 2010: 734) on crime are not criminologists but practitioners. Police, legal professionals, and corrections officials – who, more often than not, have a vested interest in controlling media narratives (Crepault, 2017) –are typically invited to provide the commentary on crime (Uggen & Inderbitzen, 2010). Criminologists, by contrast, are treated with scepticism by the general public; they are positioned as 'elite interpreters' (Crepault, 2017: 801) attempting to educate an uncritical and ignorant mass whose (mis)information on crime comes from distorted media representations. Currie (2007: 176), therefore, asserts that 'the public presence of a vocal and influential criminology has never been more critical.'

Efforts towards 'public' scholarship have been adopted by multiple disciplines as a way to disseminate knowledge to wider audiences, and criminology is no exception (Uggen & Inderbitzen, 2010). 'Public criminology' is a strand of scholarship that aims to bridge the abovementioned divide between 'academic' and 'popular' discussions on crime (Hamilton, 2013). This demands enquiry as to who or what 'publics' are to be engaged (Piche, 2015). For Newman and Clarke (2009), the term simultaneously expresses collectivity (shared public interest), reinforces boundaries between group identities (publics), and marks difference between spaces, spheres, and services (public versus private). Carrabine et al. (2000) argue that a 'public' criminology not only entails ideological engagement with the causes of social exclusion, but also advocates on behalf of offenders and the (marginalised) communities from which they are typically derived. Its central premise is to disrupt boundaries and promote collectivity; to form the connective tissue that binds theoretical and applied academic research, political and media debates that influence social policy, and efforts towards the empowerment of individuals and communities.

Students, however, seldom feature in criminological debates on the 'publics' to be engaged. For Uggen and Inderbitzen (2010: 740), '[t]eaching as a form of public criminology offers particular relevance and urgency because our classes often comprise future criminal justice practitioners who soon will be in the trenches as lawyers, police officers, parole and probation officers'. And yet, despite their assertion that teaching, and research are of equal importance to public criminology, there have been few attempts to apply theoretical scholarship to pedagogic practice. Hamilton (2013) is a notable exception. She draws on the five principles of public criminology identified by Carrabine et al. (2000) - transparency, applied in orientation, evidence-based, committed to empowerment, and an emphasis on social justice and human rights – to explore the pedagogical implications of calls for a criminology that is 'more engaged and outward looking' (Hamilton, 2013: 21). The remainder of this paper, therefore, argues that student empowerment is central to achieving the aims of public criminology. It focuses, in particular, on Freire's (1970/2014)

notion of praxis, the application of skills and knowledge through reflection and action, as a means to empower.

Developing a pedagogy of public criminology through praxis

Currie (2007: 186) warns that one such effect of the marginality of criminology described in the preceding analysis is that students graduate into criminal justice professions with rich theoretical understanding of crime causation and a desire to change the system but are 'socialized into a sort of careerist timidity.' Marginalisation, in other words, is 'domesticating' (Freire, 1970/2014), for it can normalise high rates of imprisonment. As such, teaching and learning practices should better inform students about the realities of the criminal justice system and equip them with the practical and communicative skills to engender social change. In the context of a pedagogy of public criminology, empowerment should be woven into the fabric of education through self-reflection, collaboration, communication, and dissemination (Hamilton, 2013). To this end, this section draws from my experiences as a Lecturer in Criminology at the University of Hertfordshire, and particularly from a 30-credit third-year undergraduate module I designed for the academic year 2020/21 – Rehabilitation of Offenders (RO) - to illustrates its potential.

The teaching of criminology is not 'determined by professional bodies or accreditation boards' (Hamilton, 2013: 22). In the UK, the Quality Assurance Agency for Higher Education (2019) publishes a Subject Benchmark Statement for criminology; but, by their own admission, it is a resource intended to help universities develop, rather than to regulate, course content. One advantage of this lack of regulation is that it gives lecturers considerable latitude in terms of the content offered (Hamilton, 2013) and, consequently, to incorporate the dialogic approach that is at the heart of Freire's (1970/2014) writings on the transformative potential of education.

For Uggen and Hartmann (2010), the field of criminology should better enable dialogue between course providers by making public resources such as reading lists, seminar activities, and teaching practices to facilitate peer review. However, attempts to promote transparency, while valuable for lecturers, do not necessarily empower students. Here, there is considerable scope for greater student involvement in course design (Lumsden et al., 2019). A dialogic approach (Freire, 1970/2014) should be central to this process, bringing staff and students together to improve content. Its purported advantages include greater student engagement, in turn enhancing confidence, critical thinking, and retention (Bergmann & Sams, 2012; Lumsden et al., 2019). For example, the occupational therapy faculty at the University of Missouri found that engagement increased after asking a small team of students to work with staff on the design of a module (Henderson et al., 2020). They conclude that students gained new perspective on how courses are designed, while educators benefited through fresh eyes on existing material and suggestions for new content. Placing faith in students in the design of course content demonstrates that they,

too, ‘know things’ (Freire, 1970/2014: 122); it can tap into enthusiasm for criminology as a subject of study in such a way that promotes engagement and increases satisfaction.

Student involvement in course design also promotes in-person teaching that is more active, through greater collaboration and problem-solving activities (Bergmann & Sams, 2012). Problem-solving can better prepare students for the tasks they may be required to perform upon graduation (Burke & Fedorek, 2017). Power relations in the classroom are reconfigured (Freire, 1970/2014): lecturers adopt a learning-oriented as opposed to teaching-oriented approach (Roehl et al., 2103). This is a model I have attempted to emulate in the RO seminars, through abridged case studies of probation supervision meetings I observed as part of a previous research project. Students are asked to work collaboratively to identify an offender’s risks and needs, before suggesting appropriate forms of punishment and rehabilitation. Module feedback indicated that students have enjoyed learning about the offender behind the offence. Indeed, I found that, once students are aware of an offender’s personal history, their suggested interventions tend to centre on rehabilitation rather than punishment. In addition, this mode of learning also empowers them with the skills to succeed in a variety of occupations that depend upon casework.

Encouraging reflection among staff and students is fundamental to Freire’s (1970/2014) praxis. Listening to students’ views and encouraging them to engage reflexively in problem-solving can help to challenge ‘common-sense’ views on crime (Uggen & Inderbitzen, 2010). For example, in her study of a module entitled ‘Crime and Criminal Justice’ – which is delivered to second- and third-year students on a social sciences degree at the University of Tasmania as their first exposure to criminology – Howes (2017) asked students to reflect on when and how their assumptions on crime had been challenged throughout the module in an end-of-year exam. She found that most students, many of whom had begun the module with opinions on crime that resonated with the prevailing ‘tough on crime’ views articulated above, developed a recognition of the relevance of theoretical explanations for crime causation.

As Freire (1970/2014: 101) reminds us, ‘no reality transforms itself’; hence, action is a prerequisite for change. If promoting self-reflection amongst students is an introspective way to challenge their views on crime, then the ‘popularisation of research evidence’ (Hamilton, 2013: 24) can be utilised to actively question common-sense assumptions. Appeals to an evidence-base are standard across social policy; however, it is paramount as a counter to the penal populism that has driven the expansion of criminal justice systems in the West (Carrabine et al., 2000). In the public criminology literature, ‘news making criminology’ - ‘the process whereby criminologists use mass communication for the purposes of interpreting, informing and altering the images of crime and justice’ (Barak, 2001: 190) – has been presented as a way to debunk myths and misinformation about criminality (Crepault, 2017). Among the approaches to news making criminology identified by Piche (2015: 78-9) are the ‘criminologist-as-expert’ and the ‘criminologist-as-journalist’.

As argued above, the 'criminologist-as-expert' is seldom called upon to respond to crime, largely because their role is to disagree with 'common-sense' interpretations of criminality. A counter to this approach is the 'criminologist-as-journalist', who seeks to 'claim control of the crime news space' (Henry, 1994: 296) and to bring criminological knowledge to the fore without the peremptory tone of an 'elite interpreter' (Crepault, 2017).

Piche's (2015) 'criminologist-as-journalist' can be thus incorporated into the design of assessments – for example, through authorship of newspaper articles and blogs - as a means to empower students with the critical thinking skills to explicitly challenge how a particular crime or criminal is reported. Mirroring the rise in podcasting in recent years, asking students to discuss crime as a form of assessment can promote collaboration through dialogue. This resonates with the rise of 'digital humanities', in which print is no longer the exclusive medium through which knowledge is transmitted (Zaagsma, 2013). Indeed, Talib (2018: 56) has recently called for a pedagogy 'that prepares students to understand, engage with, and adapt to social media'. As an arena in which much contemporary discourse on crime takes place, social media offers another productive avenue through which to actualise the 'criminologist-as-journalist' in seminars. For example, students could be asked to communicate research or theoretical concepts in the 280 characters available to a Twitter user. Such active learning can thereby help to offset the negative effects of the 'banking model' (Freire, 1970/2014) and educate students in the art of public debate.

Non-news making forms of media can also be utilised to construct and communicate new ways of perceiving crime and criminality. McNeill (2019: 147) advocates for sensory criminologies to render debates about crime more 'feel-able'. His research draws from song-writing and photography workshops with offenders to illustrate how criminal justice supervision is experienced. Indeed, such aural-visual criminologies are commensurate with a pedagogy of public criminology and a pedagogy of the oppressed. As Freire (1970/2014: 24) observed, a more critical understanding of the oppressed does not guarantee liberation, but rather, is an important step in political transformation. Encouraging students to engage critically with popular representations of crime, like songs, film, and television programmes – which, as argued above, have driven the demand for criminology courses in recent years (Uggen & Inderbitzen, 2010; Crepault, 2017) – can provide new, more empathetic ways of depicting the lived experiences of an oppressed class of offenders.

Indeed, my RO seminars often draw upon music to shine a light on offender circumstances. For example, the seminar on 'mass supervision', or the amplification of criminal justice supervision in the community (McNeill, 2019), utilises the following lyrics from Mathematics by Mos Def (1999):

> *When the average minimum wage is $5.15*
>
> *You best believe you gotta find a new ground to get cream*
> *The white unemployment rate, is nearly more than triple for black*

So front liners got they gun in your back
Bubbling crack, jewel theft and robbery to combat poverty
And end up in the global jail economy
Stiffer stipulations attached to each sentence
Budget cutbacks but increased police presence
And even if you get out of prison still living
Join the other five million under state supervision

Here, students are asked to identify and evaluate the lyrics that indicate quantitative and qualitative intensifications of supervision in the community in the US and how such supervision is concentrated in marginalised (i.e. poor, African-American) communities (see Wacquant, 2009).

The best example of a pedagogy of public criminology that explicitly foregrounds the oppressed is the Learning Together programme, in which students learn alongside prisoners in a prison environment. Armstrong and Ludlow (2016), the founders of Learning Together, ground the programme in Freire's (1970/2014) Pedagogy of the Oppressed: they argue that co-learning in prisons facilitates a pedagogical environment that empowers a humanity which prison so often deprives of its inhabitants. Theoretically informed collaboration, therefore, enables both students and prisoners to reflect on and dismantle any preconceptions and to inspire actions that do not reproduce social harms (Ludlow et al., 2019).

In their evaluation of the Learning Together pilot, Armstrong and Ludlow (2016) found that, for prisoners, the programme gave a sense of belonging which effected personal change, while students developed a sense of purpose as to role(s) they could play in shaping the future of criminal justice. In this way, viewed as a 'practice of freedom' (Freire, 1970/2014), Learning Together provided a pedagogy for all, owned by no-one, capable of empowering learners with the skills and values to effect positive social change (Armstong & Ludlow, 2016; Ludlow et al., 2016). Given Hertfordshire Law School's close relationship with HM Prison The Mount, there is potential for Criminal Justice and Criminology undergraduates to be granted similar opportunities.

Conclusion

This paper has attempted to draw out some of the ways in which a pedagogy of public criminology can be practically applied to teaching and learning practices in a university setting. Given the emotive connotations of criminality, McNeill (2019) contends that seeking to render criminology more public, and thus more political, is not without its risks. Braithwaite (2011) argues that value-neutrality in the teaching of criminology is neither possible nor desirable. 'Public criminology', therefore, provides a paradigm within which to make social justice values explicit (Carrabine et al., 2000) and to advance teaching and learning practices.

For Hamilton (2013), the purpose of pedagogy of public criminology is not merely to initiate students into an ideology of social justice, but to familiarise students with data that demonstrate the links between crime and social exclusion and to imbue them with the skills to communicate this knowledge. Here, there is considerable overlap with the Pedagogy of the Oppressed (Freire, 1970/2014). Both seek to empower, to effect positive social change by foregrounding the 'ordinary' knowledge and experiences of oppressed groups. While criminology students do not face the same oppressions as people under criminal justice supervision, it can be argued that their fates are linked, for many of the former will progress into jobs (prison, probation, police, law, policymaking, etc.) that have a direct bearing on the latter. Given the collapse of academic criminological influence over political and media spheres in recent decades, students are an obvious collaborator with whom to transform structures of oppression (Freire, 1970/2014).

Through a praxis of self-reflection and (evidence-informed) action (Freire, 1970/2014), public criminology provides a productive paradigm through which to develop teaching and learning. As people who also 'know things' (Freire, 1970/2004: 122), students (and offenders) should be given the opportunity to influence the design of courses that are supported by creative, theoretically and practically relevant seminar activities and assessments. The objective is to build upon, and engage critically with, the enthusiasm for learning about crime that has driven demand for criminology in recent years. A pedagogy of public criminology that seeks to empower students to change the lived realities of the oppressed can thus contribute to reinvigorating criminology as a marginalised field.

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Mini-Projects: Day-release Practical Lab Approach for STEM related disciplines for the "new normal" Education System

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Abstract

This study presents the framework design and structure of a day-release type 'Mini-Projects' using active learning fundamentals employing a hybrid combination of Problem-based Learning (PBL) and Tasks-based Learnings (TBL) with some flavour of Flipped learning. It stimulates and motivates students to apply their knowledge, skills, and abilities (KSAs) solving a given problem without a lab-script overcoming project dilemma. The study includes student's satisfaction survey analysis confirming successful delivery to various EIEE and EINTC programmes of studies in the school of PECS at University of Hertfordshire, UK. Various recommendations are made in this study suggesting the possible adaptation of Mini-Projects activities for the use in most STEM (science, technology, engineering, and mathematics) disciplines under COVID-19 secured environments. Additionally, such Mini-Projects can effectively be used to deliver the technical coursework of degree apprenticeship or UK Government's new initiative of Institute of Technology (IOT).

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The "New Normal"

The majority of the sustainable business demand digitalization, increasing use of automation, artificial intelligence (AI) and technology convergence bridging the skills-gap for STEM disciplines (Gonzalez, H. B., 2012). Since the beginning of year 2020, the advent of Covid-19 pandemic has forced the majority of everyday life to go "online", creating a new

oxymoron “new normal”. Additionally, there is flux of new terms and phrases[1] adapted in everyday business that frequently appear in educational literature and students’ handbooks (Becker, A., 2020). Similarly, the new normal has replaced face-to-face services with online communication tools and platforms (i.e., Zoom®, Microsoft Team® Cisco® Webex, etc). However, various implementation of standard operating procedures (SOPs) based on social distancing have put technology driven work practices under pressure (Carroll & Conboy, 2020). A research article collected diverse responses from 20 universities across the world of which the majority closed their *‘face-to-face’* operations and moved to blended-digitised and some fully online education (Sahu, P., 2020). Most of these pushed traditional classroom-based teaching into *flipped learning,* which has very promising features for STEM disciplines, however; this pedagogy comes with some disadvantages for social loafer, less motivated students and the economical deprived students’ community with inaccessibility of personal devices or slower Internet connection (Tang, T. et al, 2020).

Incompetent Courses and limitations with work practices

In real world professional jobs, regardless of different disciplines, each employee performs duties consistently for 6-to-8 hours following all official protocols, taking queries using his/her skills, accomplishing the given tasks. The manager or leader takes the full responsibility, inspecting every possible aspect, researching, troubleshooting, and documenting evidence, and logging all events and actions for their intellectual property rights. Such professional attitude (all-in-one) cannot be developed comprehensively via most of the undergraduate programme of studies, but a learner adopts such characteristics while undergoing various field trials, failures, or lucky dips during their early employment. For the same reasons, it is not surprising that majority of STEM’s graduates, even after passing their team/individual major project module struggle in research methods, academic report writing, troubleshooting, analysis and synthesis of their work. School academic quality assurance (AQA) officials, programme leaders and tutors develop various resources and publish their proceedings, scripts, and handouts as online documents, most of which goes unexplored, as many learners either skim through or partially read the contents. Consequently, many graduates require additional project management and technical or professional certificate courses for sustainable employability.

Realising all such complex issues, the UK government has announced £102m visionary Institute of Technology (IOT) to promote technical skills and abilities (Gov.UK, 2020) and University of Hertfordshire is among the 20 selected IOT for England, expecting to deliver

[1] synchronous/asynchronous, asymptomatic, vanguard, herd immunity, bubble, cluster, social distancing, quarantine, self-isolation, fatality rate, flattening the curve, essential business, smart lockdown, covidiot, covid-secure, droplet transmission, screening, sanitiser, PPE, etc.

specialist areas in 1) Construction and the built environment, 2) Life sciences and pharmaceuticals and 3) Digital: focusing on digital technologies, data analysis and artificial Intelligence.

Additionally, several social distancing and COVID-secured workplace settings have not only reduced overall physical and human interactive resources but have created a skill's vacuum as junior staff cannot effectively cover any absences of senior staff. As a result of this, many retail businesses could not survive. Similarly, many schools have adopted online learning, teaching and assessments leaving less opportunities to get hands-on training skills (Telles Langdon, 2020). Stuffing almost everything online has provoked many talented learners, demanding higher educational institutes to refund their partial tuition fees (Ahlburg, A. 2020). The OfS also advised English universities for the partial refund.

Furthermore, the COVID-secured alternative assessment arrangement (AAA) methods for most of the lab, practical work and E&T projects have replaced the regular AQA approved assessments with almost essay-type coursework or computer simulations. This comes at the cost of some compromises on learning outcomes, despite best staff/students' efforts, i.e., rapid revision of various DMDs of courses to 100% coursework, possibility of inconsistency in moderation process, skipped/unreported double-blind marking, less support of additional/special needs arrangements, no referred/deferred options, potential collusions/essay-mill etc. Some of the students with limited or no Internet access could not attend the scheduled assessments (this included some UK/EU and International students, who went back to their countries of origin and were unable to attend scheduled online exams/viva due to GMT vs local time difference or unavailability of resources).

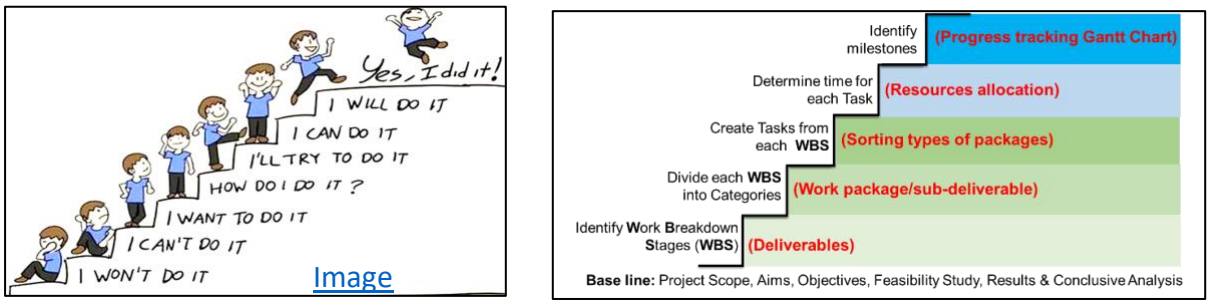
Mini-Project Module, where learners love challenges

Historically, Mini-Projects were conceptualized in the School of E&T funded by AdvanceHE (*former* HEA) Engineering Subject Centre and JISC promoting problem-based learning in engineering discipline in year 2005 (Kate Williams, 2005). Since then, the Mini-Projects module team has developed extensive experience in designing and delivering this module in School of PECS. With increasing use of easily available digital electronics project kits, project boards (raspberrypi and Arduino), Internet of everything (IoE) sensors, mobile convergence, digital computing and apps (Jamro, M., 2017), the traditional learning, teaching and assessment of any STEMs laboratory practical can be delivered as small day-projects, similar to a Mini-Projects module.

It is crucial to create interesting short projects avoiding too many interconnecting circuits, computer-assisted or computer simulations as many of the learners will be unaware of default assumptions of the numerical models and simulated scenarios, and consequently, many might continue their practical lives with misconceptions. For example, one of the early education studies revealed the adverse impact of overuse of computing resources in classroom activities (Jacob, T. 2019). Despite, heavy use of Internet, one obvious everyday

'IT compliance' issue is to keep using default Wi-Fi settings of broadband wireless routers in homes and offices. Any hacker can easily get a list of a company's generated default list of usernames and passwords compromising all their smart-home devices and appliances, leading to serious bank and financial frauds (Knapped, E. D., 2011).

For many, it is quite challenging to start a project if various psychological pressure stages are not acquainted accordingly. For a beginner without any project management experience each of these stages are not less than a nightmare as illustrated in pictorial motivational stages in **Figure 1(a).** If these psychological pressure stages are properly calibrated for learning and assessments then these can be translated into milestones of a true project. This is illustrated in **Figure 1(b)** as a staircase of Work Breakdown Stages (WBS).



(a) (b)

Figure 1. (a) Motivational stages of a project, (b) Work Breakdown Stages (WBS) of a major Project.

It should be noted that this requires a more professional attitude to initiate a project, hence the project lead person (e.g. supervisor or team leader) must have a 'thought-process' with clear aims, objectives, some form of feasibility study, theoretical results or hypothesis, or some conclusive analyses (Norman, E. S, et al, 2008). It will help the learner to develop a sustainable plan, creating 'deliverables' and sorting packages for resource allocations. These WBS are knotted within the Mini-Projects Framework addressing project mindset so that each given task can be implemented effectively within the allocated time with identified work-effort commitments.

Mini-Project Framework (MPF)

The day-released type module and its framework is proposed based on hybrid project-based and tasks-based learning, where students attend one day per week (Jamro, M et al, 2020). It is suitable for a 100% In-Course Assessment (ICA) module, intended for Level 5 students of Second Year - Second Semester. Due to the practical limitation with module delivery, the failure grade or absentees must re-enrol for next year, hence unlike many other modules, this has no referral/deferral ICA. The module delivery schedule is set for 12 teaching weeks (one semester). These are divided into 2 +1 +9 = 12 teaching weeks.

Two weeks: First week#1 as an Induction week and week #11 as a Reflection cum-Appraisal week.

One week: Final week #12 is set as a spare, covering any study needs agreement (SNA) or compensating severe adverse circumstances (SAC) etc.

Nine weeks: 3 Mini-Projects for students' work and Assessments, each covering 3 weeks per single Mini-Project.

Week #1 and Week #11 have distinct features of Mini-Projects, where the first teaching week is dedicated to Module Induction Week, where the module co-ordinator (i.e. module leader) invites Academic and Research office bearers or their nominated representatives, including, the Associate Dean of School (ADoS) for Learning & Teaching; Library Information manager; Programme leaders; Project/Placement Tutors and Supervisors to share the current industry project demands and professional codes of conduct that students are expected to explore during their Mini-Projects and in foreseeable future research modules. Some invited students of past/previous years (e.g., now registered onto their Level-6, 7 and Level-8) also share their experience and viewpoints either online or via recorded messages. Week #11 is dedicated for student's one-to-one confidential meeting session with module leader providing an opportunity to reflect and appraise, identifying issues and enhancements. Week #12 is kept free to compensate for any missed deadlines or allowing extra-time students to complete their any remaining work. The remaining nine teaching weeks are Mini-Projects 'work weeks', where students complete three Mini-Projects (each single Mini-Project completes in three weeks covering one-day-per-week).

Two out of three Mini-Projects are based on lab-based practical work and each learner undergoes similar type assessments (including formative and summative). During each ICA submissions, students are given prompt feed-forward type feedback ensuing 100% use of given feedback in their next assessment as illustrated in **Figure 2**.

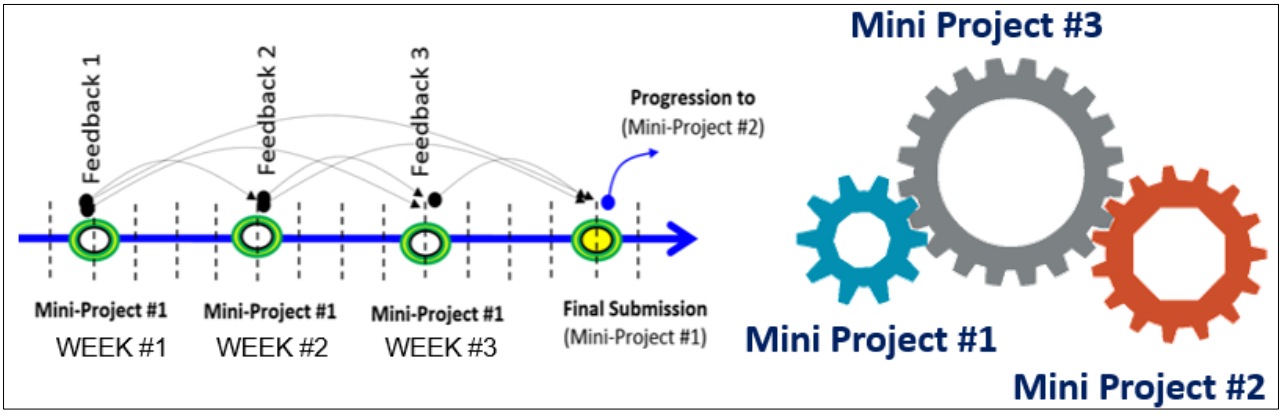


Figure 2. Feed-forward type Feedback and Mini-Project Module experience cycle.

The first two Mini-Projects are based on two independent projects but related to their core subjects, hence learners capitalise their experience using given feedback accomplishing

these two projects, individually. The third Mini-Project is unique that is a comparative study of the two projects. This is set as a groupwork ICA, challenging learners' reasoning, effective listening and negotiation skills whilst exploring main learning outcomes (LOs) of the module, including various types of Intellectual Property Rights (IPRs), Industrial Compliance (CE, EMC, RoHS, WEEE etc), Legal, Social, Ethical and Environmental issues, protocols and Trade related aspects and impacts (i.e. BREXIT, COVID-19 etc). The group-work also requires developing a 'Sustainable Business Plan' for any one of the chosen projects. Such LOs enhance entrepreneurship and employability opportunities, exploring and linking multi-disciplinary subjects (e.g., Electrical, Electronics & Communication/ Mobile & Networking/ Computing & AI/ Mechanical & Automation/ Aerospace & Satellites/ Biomedicine & Environment/ Smart Home & Commerce and Businesses etc).

Feedback plays a crucial role in any assessment. The Module leader/coordinator analyses and prepares a confidential summary of MLOs for each component (i.e., knowledge, understanding, creativity/problem solving, reflection, self-management and personal development, communication, and information technology literacy etc) as described in Table 1. This is an additional bit to the regular Canvas Module assessment that was shared with supervisors to visualise assessment landscape thereby developing personal profile of individuals.

Table 1. Mini-Projects Module Assessment and Feedback Sheet.

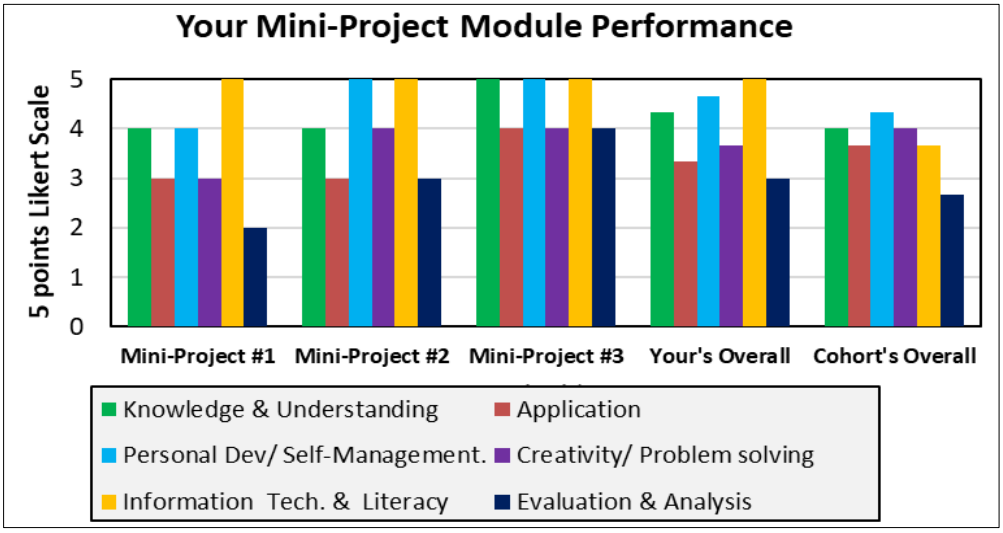
Mini-Project Assessment Sheet (CONFIDENTIAL)																		**Mini-Project Title:** _____ **Mini-Project No:** _____						**Module Code:** _____ **Supervisor:** _____
Project Segments		Achievements in Labs* (70%)								Academic Report Writing skills* *Submission online* (30%)						Project Av:	**Comments/Feedback to Students**						
Distribution of Marks for this Mini-Project		Assignment 1 *Prep. Day (10%)*	Assignment 2 *Day 1 (30%)*			Assignment 3 *Day 2 (30%)*				Assignment 4 (*work from home*) *(30%)*						100%							
Project Requirements	Ethical: Human participation (if any) Extra hours support Internet Access Hardware/Software Student Proctor Technical Staff	**Preparation Day** *(Students learn & explore about the project requirements)*	Task 1 Achievements	Task 2 Achievements	Task 3 Achievements	Task 4 Achievements	Task 1 Achievements	Task 2 Achievements	Task 3 Achievements	Task 4 Achievements	Presentation	Subject Review	Modeling & Exp. set-up	Screenshots of Results	Analysis & Discussion of results/outcomes	Referencing & Future Trends	**Mini Project Exercise Total Marks**	The written feedback in plain English language without using technical or pedagogic terminology. The automatic feedback will be generated from the database (as shown in Appendix-A) using the score from the Likert scale as shown below.						
																		Likert scale (5 points)						
Student Reg. Number																		Knowledge and understanding	Application	Personal Dev/ Self-Management.	Creativity/ Problem solving	Information Tech. and Literacy	Evaluation and Analysis
Sample: 123456789																							

**The students save their Elogs (containing researched information, results, analyses, screenshots etc) in their online individual folders at the end of each Assignment 1; 2 and 3, which they will use for developing the formal report. The necessary templates are introduced on Induction Day to develop and guide students producing meaningful Elogs and Formal report.*

At the completion of the module, a Liker's score summary is shared with individuals confidentially (along with their final module marks) for their self-reflection, showing their individual performance/achievements/skills vs their cohort's overall result as shown in **Figure. 3**, representing an anonymous student's profile shared in the final grade reflection-

cum-appraisal 11th week. This can be helpful to analyse staff-student's efforts and throughput and is used as means of reflection-cum-appraisal, where the student visualises his/her calibre and explores own-self on the basis of SWOT (strength, weakness, opportunities, threats). Such practice will eventually boost the student's led partnerships making their future employment more sustainable.

Figure 3. Comparative Summary of Individual (confidential) vs Cohort's Achievements



Students' Learning Experience

Two surveys were conducted with students registered on EIEE and EITNC programme of studies for BEng and BSc, respectively, in the School of Physics Engineering and Computer Sciences (PECS). As given in Table 2, the first survey containing five questions was offered to students at the 'start of the module' (SoM) after completing two out of three Mini-Projects. The second survey was issued to students at the 'End of the Module' (EoM) when they had completed all three of their Mini-Projects. Due to COVID-19 circumstances, the second survey was issued to participants using Online Survey Monkey.

Table 2. Students' Satisfaction Survey Questionnaires.

Survey- I: Start of the Module (SoM)		Survey- II: End of Module (EoM)	
1.	Mini-Projects were useful and enjoyable	6.	The three Mini-Projects were equally useful (although not related or linked to each other)
2.	I used the knowledge from past teaching modules/Labs	7.	I developed confidence by solving the practical problems on my own
3.	I accomplished most of 'the tasks of the day' on time	8.	I believe that Mini-Projects experience will be useful in seeking placement, Final year project

			and doing Labs and writing reports for my other core modules' Coursework Assignments.
4.	Doing Mini-Projects, I feel more like a lead person, organising and managing data by creating E-logs and self-reflecting via Blogs.	9.	More practical should be covered like this module instead of traditional Lab-based coursework.
5.	I proudly share my hands-on training and learning experience on social media (i.e., YouTube, Facebook, Twitter, Instagram, LinkedIn etc)	10.	From the knowledge and skills gained from this module, I can develop at least one useful Mini-Project to help Level-4 (first year) students
		11.	I would recommend the Mini-Projects module idea to be considered within other programmes across the University (i.e. Science, Technology, Engineering, Maths and other practical oriented disciplines)

In order to workout recommendations for STEM type module, the 'Favourite' results presenting overall students' satisfaction, the neutral responses e.g., neither were taken as undecided voters or who wish not to have their say, (i.e., rejected votes based on degree of freedom for probability statistic). The nature of any bipolar response scale (with neither at midpoint, e.g., the Likert scale 7, 5 and 3, have midpoints at 4,3 and 2, respectively). A large population at midpoint cannot be ignored but a smallest number can be reduced if there were no additional comments from this group. The formula for deducing the net favourite response, excluding the rejected vote can be given as following:

$$\text{Favourite} = \frac{(StrongAgree+Agree)-(StrongDisagree+Disagree)}{(Total-Nuetral)} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Figure 4 shows the analytical result of the students' satisfaction survey of both questionnaires. The primary Y-axis represents the normalised 5-points response in percentage, whereas the secondary Y-axis displays the deduced favourite response for net positive. It can be observed that minimum net positive response remained above 60% for all questions, whereas the maximum can be seen as 100% for some question number 5 and 10. The combined average of both cohorts can be found in between 75% to 80%. The linear trends shown with dotted lines for both BEng and BSc cohorts contains a consistent 10-15% gap between each trend that can be seen as motivational distance.

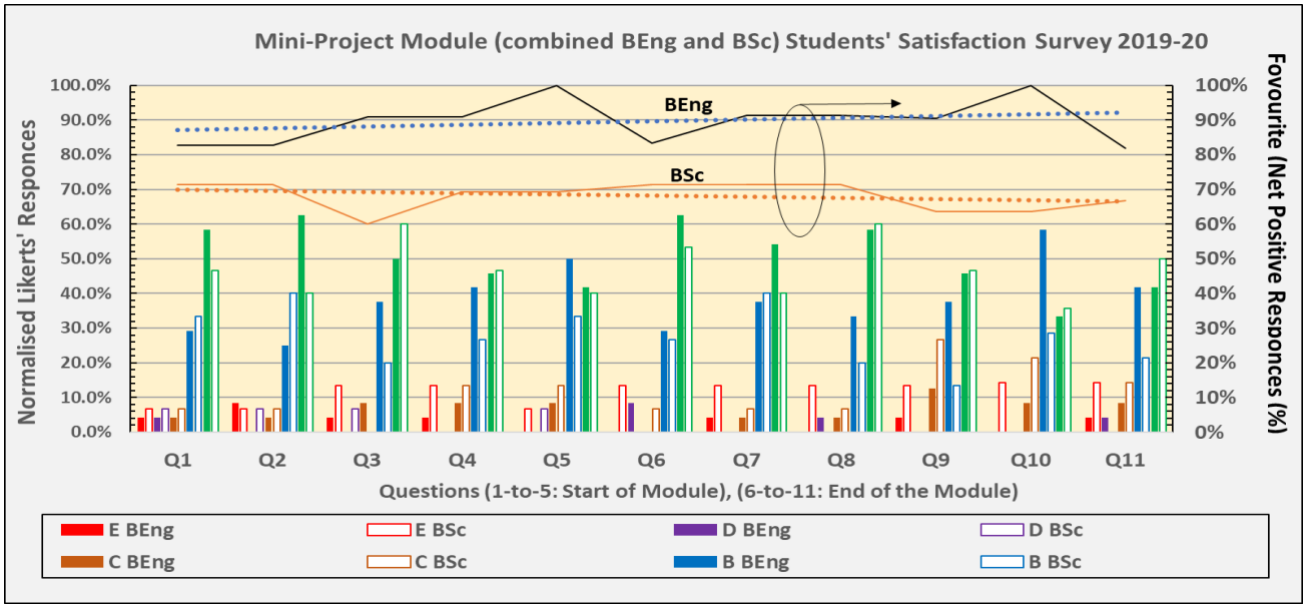


Figure 4. Students' Satisfaction Survey of Module: BEng and BSc cohorts of School of ECS, for the programmes of Studies EIEE and EIETC.

The true factors behind this gap are yet to be analysed, however; in student's feedback appraisal it was realised that a majority of engineering students love sitting long hours in the lab, doing individual tasks, whereas the technology students did not like sitting in the lab for longer hours, exploring circuits, simulations and theoretical work but actively participated in systems and networking activities. Also, some BSc students came from direct entry into second year and had not thoroughly covered prerequisite modules of first year. Thus, believed that several topics were 'out of course' and students covered these themselves, considering some extra-work as their formative assessment. These motivational factors might have increased optimism in BEng students survey to give 5 points for value of 4.5, whereas the BSc students might have downgraded 4.5 to 4.0 for the similar experience with reduced motivation.

Mini-Projects Showcase

Useful exemplars were showcased during the Students' Induction week and Start of the Module (SoM) Survey networking events, sharing Module good practice. Here, some of the images are reproduced in **Figure 5** and more can be shared via UH-SharePoint or can be made available on request.

Figure 5. Showcased images: pre-COVID-19 Mini-Projects Module Showcase event.

Recommendations

The rigorous moderation and evaluation process in existing Mini-Project module in former school of E&T helped making this module sustainable and versatile for both engineering and technology disciplines. Further innovations during this project made this module to be suitable for most of the STEM disciplines using the following recommendations.

A. The selected Mini-Projects should have currency and be diverse enough to cover the variety of practical aspects of STEM related programmes of study that are taught in relevant modules. It is important that students should be exposed to practical troubleshooting aspects and issues providing the opportunities to explore the possible solutions. The possible solutions and learning outcomes must be based on knowledge and skills acquired from the past semesters (i.e., in-course assessed ICA assignments, laboratories, workshops, and Examinations). Students recycle, reuse, and repurpose their learning that enhances student's self-esteem and self-confidence.

B. For sustainable employability, the students should be offered Mini-Projects across the disciplines, not just related to their own pathways. The Mini-Projects module leaders (i.e., module co-ordinators of different schools) must meet regularly to plan possible development and integration of various team-based mini-projects activities across the STEM

disciplines. This widens the scope and vision of their applied subjects, ensuring the sustainable employability of young graduates.

C. In Year 1, it should be made clear to students (i.e., during Induction and in programme board meetings) that the Mini-Projects module requires their maximum efforts as this is linked to their industrial placement year and brushing project management skills. In order to persuade young STEM's undergraduates, following fundamental issues must be discussed with the Module and Programme team.

D. The developed Mini-Projects must allow students to apply the knowledge, skills, and their abilities to solve the practical problem. This helps to develop their personal development assessment (PDA) planning ensuring the learning of their transferrable skills.

E. The LO's must be assessed accordingly confirming the student's ability to design and carry out the experiment. This reinforces the LO's of past modules related to placement study and core modules. Furthermore, the Module team should also ensure that the tasks of the Mini-Projects are structured appropriate to the UK Professional Standards Framework (UKPSF) and an average student can work on his/her own without requiring frequent supervision. This will help influencing the learners' behaviour towards project management simplifying major project supervisions in their final year and supporting their industrial placements.

F. Due to the day-release nature of the module, it is important to engage learners in stimulating tasks otherwise they will feel boredom and try shortcuts, leading to cheating or just passing the module. Sitting in the lab for a day can be quite demanding for Second year - Second Semester students (some of these may be direct entry or transferred from other courses). Therefore, programme committee team must introduce some project-day sessions in Second year - First semester supporting transition from traditional-lab to individual open-ended investigational projects.

G. This type of module can easily fit within the new Degree Apprenticeship Programme (DAP) due to its day-release delivery features as many workplaces may not allow their employees for more than a day per week. This, however; challenges the timetabler and academics to distribute evenly the available physical spaces and their flexible availability.

H. Most of STEM disciplined school can adopt Mini-Project type lab-based modular structure for their practical work implementing COVID-19 social distancing protocols, where many courses and assessments have been set for online delivery (i.e. flipped classrooms, working from home). This one-day per-week project-style labs can be adopted for multiple practical laboratory work subject to availability of resources (i.e., on-site technical assistance, partially readymade project kits to be sent to students' premises/home, templates and tutorials and creating suitable tasks leading to completion of a desired project work, etc). Therefore, such practice can also be imitated in school of PECS covering

‘engineering days’ exercises or developing new courses for UK governments’ new initiative of IOT for Digital technologies, data analysis and Artificial Intelligence/Machine Learning (AI/ML) based labs and coursework for increased competency.

I. Level-6 students (who passed this level-5 module with good grades) should be encouraged to help their juniors of level-5, and School(s) can issue certificates of merit and some reasonable reward/wages as a bursary in recognition for their supportive work as student’s proctor assisting Mini-Project supervisors.

J. Level-6 students can be asked to design and develop one Mini-Project from their Final Year Major Project or returning from Industrial Placement. This enhances students’ workability and creativity leading to much needed skills and concurrent co-creator agenda of Students as Partners (SaP). In addition, school will enlarge their Mini-Projects pool.

K. For widening participation, the university must develop a virtual and physical STEM-club, where students can share their project stories, upload, and display their developed projects and explore further their innovative ideas. This can be extended to local and international projects events inviting enthusiastic game developers and entrepreneurs.

L. Students’ Union can help developing Buddies and Protectors, supporting academic staff in assisting students in the labs. This develops strong bonding between students and staff as an associate, rather than student-staff. Since the buddies and proctors spend more time in the lab closely observing senior staff assessing and supervising students, therefore; they can easily adopt the professional attitude, increasing staff-students’ engagement partnerships.

Conclusions

A framework design and structure of the Mini-Projects module suitable for the STEM’s discipline was developed and discussed, making useful recommendations for various stakeholders to bridge the skills-gap. For enthusiastic academic researchers, guidelines of work-breaking-down stages for a longitudinal study were proposed to create up-to-date specific or multi-disciplinary Mini-Projects for various cohorts. The students’ satisfaction surveys (before and after completing module) revealed popularity (i.e., liking) of this approach, where students completed their work under limited staff’s support. The survey displayed a net-positive response of above 80% and 60%, for the students of engineering and technology, respectively. Students appreciated the prompt and feed-forward type feedback on their assessments, the staff’s presence and online/offline support in the lab for the entire day and finally the confidential appraisal developed co-valent bonding between students and staff. Further implementation of proposed framework in multidisciplinary subjects and supporting students’ union in creating students’ buddies and proctors will create more opportunities of student-led partnerships.

Due to day release nature of the framework, it can be used in implementing practical degree apprenticeship programmes, and in particular catering digital competency for new upcoming Institute of Technology (IOT). Furthermore, the hybrid problem/tasked-based learning approach enables delivering multiple diverse labs as an 'engineering-day' exercise covering regular programmes of study in the current COVID secured or post-lockdown environments offering learners hands-on training acquiring much needed skills for the modern hi-tech engineering solutions.

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Enhancing Engagement with Recorded Lectures using Formative Quizzes

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Abstract

Online student engagement has become a subject of importance in the face of the global Covid-19 pandemic. Campus lectures have been replaced with recorded videos which has led to detachment and disengagement. To increase the engagement with recorded online lectures, a gamification approach was adopted. Formative quizzes were appended into the existing videos. Two approaches were trialled, approach 1 directed students to a quiz after the video and approach 2 asked the students to create quiz questions during the video. Results were ultimately inconclusive however during the transition period to online videos some \\changes impacted on engagement such as shortening the videos. Lessons learnt from this work, could help those trying to enhance student engagement with recorded videos and quizzes in an online context.

Introduction

With the pandemic forcing courses to move online physical lectures have been replaced with recorded sessions. Due to the swift transition, recorded sessions were based on the content and delivery intended for face-to-face sessions. Quizzes, arguably the simplest form of gamification, are a popular and accessible way that could increase engagement in an online environment. In this paper we will focus on improving engagement in this pandemic context, by investigating how we can use formative quizzes to enhance engagement with recorded lecture videos.

The module this paper will consider is an on-campus Computer Science MSc module based in the UK teaching Data Mining on this module, most students are international students. The module teaches the students Data Mining algorithms from theoretical, practical, and ethical perspectives. The students work well together and are highly committed around assessment, however, participation with non-assessment tasks can pose a challenge. Furthermore, the students are often learning in their second language therefore comprehension problems can arise. Lastly, the student's expectation is more in line with a didactic approach than constructivist approach. This paper investigates whether the inclusion of quiz / social activities increase student engagement, by connecting with student's strong focus on assessment and social activity.

Literature Review

Student engagement is essential to learning, the Advanced Higher Education states that "The amount of time and effort students invest in their studies and how students engage with learning is closely linked to their level of academic achievement." (AdvanceHE, 2020). However, while "the amount of time" is possible to measure, "how students engage" is difficult measure and contentious to define.

Applicable to our work is Moseley's Model of Engagement. Whitton and Moseley note that engagement has different constructions (Whitton & Moseley, 2014). Their work focuses on gamification, and in this work, we will consider formative quizzes as our gamification. Although, it is acknowledged that Whitton and Moseley's work is based on a literature review on "digital entertainment games" which does not consider quizzes as discussed in this work (Boyle, Connolly, Hainey, & Boyle, 2012). Hence, this could limit the generalisability of the model.

Whiton and Moseley point out that engagement with education and games are not the same. They state that education may be extrinsically motivated, but gameplay is intrinsically motivated (Whitton & Moseley, 2014). Whitton and Moseley propose a model of engagement, "Involvement with Learning" with six dimensions. These provide a lens through which we can deconstruct engagement. Their literature review finds that deep engagement is associated with intrinsic motivation and superficial engagement is typically extrinsically motivated (ibid).

The first dimension of their model is participation, described as engagement as doing. This is easy to quantify, and in our work, we can quantify participation in terms or viewer retention and quiz completions and discussion posts. The second dimension is attention, described as engagement as commitment. This is commitment of attention and cognitive activity. This is challenging but possible to quantify on under on-campus circumstances, by looking for tells of attention and concentration, but within an online context this is much more challenging to assess. The third dimension is captivation, described as engagement as enthrallment. This dimension is like the second, but deeper, where the students are absorbed in thought and fully concentrated. The fourth dimension is passion, described as engagement as feeling. This dimension is the emotional pull the students feel. It could be easy to write off this dimension for the seemingly prosaic field of Data Mining, but within our field, tackling man's biggest problems with Data Mining can be emotive. Like the previous two dimensions this is hard to quantify but certainly can be communicated to the students through course content such as the recorded sessions, so it can apply in an online context. The fifth dimension is affiliation, described as engagement as belonging. A sense of belonging and identity within the module can be created through using of positive imagery. This is embodied in our module through using the pictures of the researchers, especially where they are aligned with the backgrounds of the students taking the module. The sixth dimension is incorporation, described as engagement as being. Being, owning and creating part of the

activity. This connects with the idea around collaborative learning, where the lecturer is in a facilitatory role. Dimensions 1 and 2 can be superficially motivated extrinsically, while dimensions 3-6 are deeply and intrinsically motivated (ibid).

Using these dimensions as a lens we can consider our improvements to the module, mostly notably the formative quizzes. One of the benefits of using the formative quizzes is that students are intrinsically motivated to play, and this defined as deeper motivation. However, a danger with engagement within games is that the students may not be focused on the learning objectives, and instead focused on the score, cheating, or just the entertainment value. In the context of using formative digital quizzes which bare a similarity to a game, if the link between the game and learning task is tenuous then learning may not take place. (Iacovides, Aczel, Scanlon, Taylor, & Woods, 2011)

In the area of formative quizzes, Kibble's research investigated incentivising students to complete formative quizzes by offering a mark for completion, regardless of the grade achieved in the formative quiz (Kibble, 2007). They offered course credit (up to 2% of the total credit) and saw increased participation from 52% up to ~90%, with 90% percent of the students reporting that they engaged with the quiz primarily due to the credit (ibid). Another paper looking at incentivising students to engage with course content extrinsically was using periodic tests to encourage procrastinator students to maintain their studies due to the need to complete the periodic tests. It should be noted that Tuckman's work was in-person and therefore the students had to participate in the test (Tuckman, 1998). Kibble and Tuckman's work demonstrates that extrinsic motivation, (referred to as superficial engagement in the Whitton and Moseley's model) can be usefully applied, while not necessarily deep engagement. A counter argument to this, is the notion of intrinsic and extrinsic motivation is akin to "Theory X" vs "Theory Y" management approaches within the area of project management / motivation theory. A "Theory X" management style assumes that workers are extrinsically motivated (student do not want to learn) while a "Theory Y" assumes the motivation is intrinsic (the students want to learn). The consensus is that "Theory Y" management produces superior results (Lawter, Kopelman, & Prottas, 2015) which aligns with Whitton and Moseley's stance.

While Whitton and Moseley look at engagement with digital games, Redmond et al. looks at online student engagement in general. Their survey paper proposes a conceptual framework for online student engagement in higher education in Australia (Redmond, Abawi, Brown, Henderson, & Heffernan, 2018). They break student engagement down into cognitive, behavioural, collaborative, emotional, and social, engagement dimensions. Many of the dimensions are like Whitton and Moseley's model. In their framework, cognitive engagement is defined as "the active process of learning" (ibid). Students who are cognitively engaged and motivated to learn exhibit self-regulation. Self-regulation is an important trait for online learners that are not under social pressure in the classroom to learn. Redmond et al. puts more emphasis on the social aspects of online learning, Whitton

and Moseley do cover this with their 6th dimension “incorporation” but Redmond et al. breaks this into two categories, social and collaborative engagement. Social Engagement is defined as creating purposeful relationships. This can be achieved online through forums where students can build rapport, respect and belonging. In an on-campus context natural opportunities present themselves, but in an online context we must nurture this.

Another model of engagement is implemented in the UK Engagement Survey (UKES). The survey compliments the National Student Survey (NSS) and was designed to help institutions enhance their practice. The UKES break engagement down into seven categories: course challenge, critical thinking, reflection and connecting, research and inquiry, learning with others, staff-student partnerships and interacting with staff. Their model is more skills focused.

The UKES shows that overall students from BAME backgrounds are more engaged than white students (Neves, 2020). This confirms there to be a different reason for the lower engagement in our module (majority international students). It is difficult to pin down the exact reason for our module, but some possible candidates are language barrier (many students are learning in their second language) or possibly due to the students transitioning from didactic teaching backgrounds to a more constructivist approach here in the UK.

The UKES survey 2020 captured a narrative of student engagement over the course of the pandemic (ibid). However, it provides a limited picture of lockdown, the data runs from Feb 2020 to June 2020, only capturing a view of the first lockdown. Furthermore, the survey askes the students how they feel about the year ***overall.*** Therefore, the student’s responses are considering some of their on-campus experience. Moreover only 23% of the total responses were recorded during the first lockdown.

Overall, UKES 2020 shows a drop in engagement of 1% in “course challenge”, “critical thinking”, “integrating with staff” and a 2% drop in “learning with others”. For the data recorded during the lockdown, “interacting with staff” increased and overall students surveyed during the lockdown seemed to be showing higher engagement overall. It could be questioned whether this truly reflected the situation. This could be initial positivity in the face of interesting change aka. the novelty effect. Additionally, it could be questioned whether this pattern persisted for the second national lockdown. UKES survey shows that working and caring responsibility significantly rose for students during the first lockdown and that students spent less time on their studies than in past years.

Moving toward our area of focus, formative quizzes. Quizzes are often used as a form of assessment of learning. However, in this work we are using them to support learning rather than assess learning. Anecdotally, it seems the use of online quizzes accelerated during lockdown for both supporting and assessing learning. This could be due to availability of good digital tools for implementing them and their simplicity of implementation, combined with their popularity outside of teaching and learning as a popular part of family virtual-get-

togethers during lockdown. There is research which supports the position that quizzes enhance engagement in variety of contexts (DePaolo & Wilkinson, 2014) (Hillman, 2011) including live session contexts during the pandemic (Morawo, Sun, & Lowden, 2020).

When producing a quiz there are different formats that can be used. However, we will focus on multiple choice quizzes since these keep the experience closest to a game. Although, restricting the questions to multiple choice, can restrict the complexity. Biggs proposes a taxonomy for learning, featuring four complexity levels (Biggs & Tang, 2011) , using multiple choice questions could limit the complexity to predominately level 2 “multi-structural” therefore not applying skills often seen in higher education such as critical analysis and evaluation.

Lastly (not the focus of this paper), but an incidental improvement made to the module alongside the changes made for this work, was reducing the video lengths. There is evidence to suggest that recorded sessions in math and science online education, should be as short as 6 mins (Guo, 2013). The hope is that by segmenting the longer recorded sessions into shorter sessions, the students are encouraged to take a break every few minutes to pause and reflect over the materials presented.

Summarising this brief literature review, it is clear there is debate around the meaning of engagement. However, by using a model as lens we can deconstruct engagement within the online context into dimensions that go beyond participation and look at aspects such as whether the students are cognitively, emotionally, socially engaged and if they are incorporated into the modules activities and identify with the module. We have seen that formative quizzes can enhance engagement through being challenging, cognitively stimulating, and providing self-regulation mechanism to the students whilst being practical to implement. The quizzes can be extended with credit incentives for completion and while making the quizzes summative was not investigated, it follows that this could increase engagement further.

Since the quizzes are very focused on the learning objective / content, this could mean they feature limited intrinsic motivational value, which could lead to lower engagement compared to other “richer” forms of gamification. Formative quizzes use the active recall paradigm and after watching a video should promote learning. Technology allows the easy deployment of formative quizzes in the current pandemic context. The pandemic has not massively damaged student engagement according to the largest survey of engagement in the UK. Furthermore, other activities where the students create content could promote engagement as incorporation, i.e., students creating content and collaborating with other; in line with the adage “You never really know something until you teach it to someone else.”.

Methodology

Two videos were selected for improvement from the same week in the module. The first video chosen was “Classification” with a runtime of 45:49, the second video was “Clustering” with a runtime of 43:24. The videos were uploaded to Canvas each week to replace the on-campus lectures which were no longer possible for the Semester A (September 2020) run of the module due to the pandemic. In the previous run of the module with ~150 students the viewer engagement statistics seen in Figure 1 and Figure 2 were achieved.

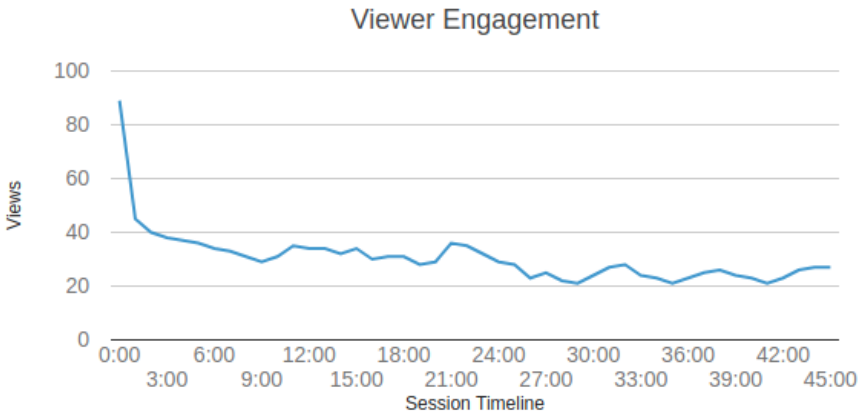

Figure 1 - Classification video engagement as shown by Panopto (video sharing platform) - it appears many people many viewers are lost over the first 9 mins, there is a peak of students skipping part of the video between 20 and 24 mins, viewers remain mostly consistent after this.

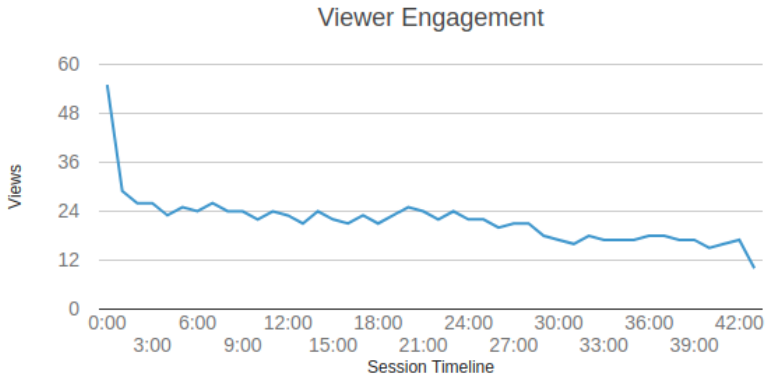

Figure 2 - Clustering video engagement as shown by Panopto (video sharing platform) - it appears many people start the video instantly leave before the 1 min has pasted, a few further viewers are lost at the 2min mark, then the viewers remained fair constant until 28 mins at which few viewers are lost.

In this work we will improve this content for the Semester B (Jan 2021) run of the module. As part of other changes to the module the classifications and clustering videos were both moved to week 2. Engagement with the classification video (Figure 1) is higher than the clustering video engagement (Figure 2). A likely reason for this is the first week (containing Classification) of the module is better attended by students than the later weeks.

Also as part of other changes to the two videos, the “Classification” video was cut into five videos: “Introduction to Classification”, “Information Gain Decision Tree”, “Naive Bayes”, “Linear Regression” and “Improving Classification Accuracy” and the “Clustering” video was cut into three videos: “Clustering Introduction”, “Clustering Metrics (and Distances)” and “Clustering with K-Means”.

A quiz question creation activity was added to the “Clustering Introduction” video. Targeting the 6th dimension of Whitton and Moseley’s model of engagement (Whitton & Moseley, 2014). Figure 3 shows the scenes of the video.

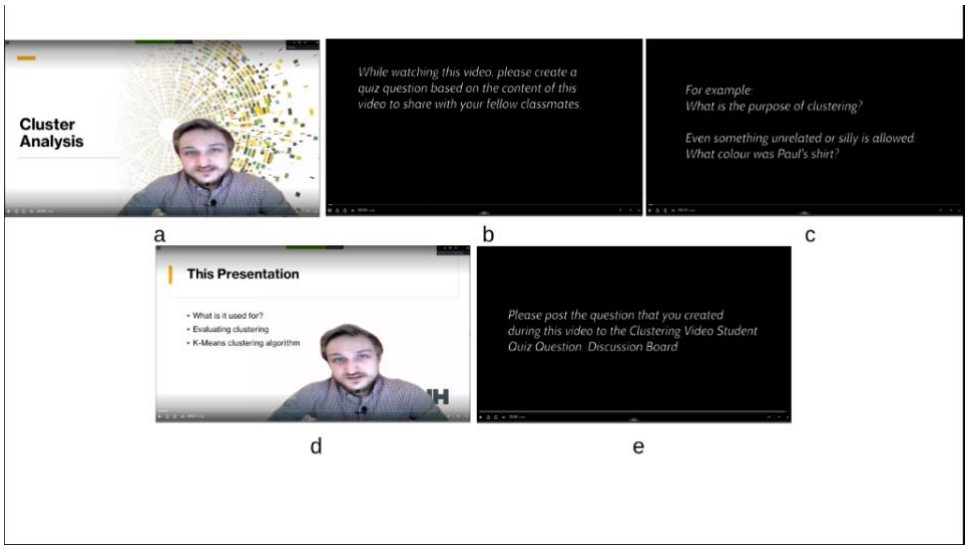

Figure 3 – the video is introduced, b. next the video cuts to the instruction, c. examples are provided, d. the video contains as normal, and finally e. remainder to post their question is shown at the end of the video.

The “Clustering Metrics” and “Clustering with K-Means” videos each had a mini quiz added. The mini quizzes were implemented in Canvas. Figure 4 shows the scenes of the Clustering Metrics video. A link was placed directly below the video for easy access to the quiz. With the transition to an online mode of study, using recorded sessions, the instant feedback that would normally be accessible to the lecturer through asking questions of the students and seeing the student reactions is removed. Adding the quiz allows learning to be assessed in formative way, as per the theory of constructive alignment (Biggs & Tang, 2011). The quizzes also provide feed forward feedback, this is shown by the quiz in response to incorrect answers. The quizzes each had 4 questions, allowed multiple attempts, and immediately showed the students their score and feedback. The questions were multiple choice. Table 2 in the appendix shows the questions used.

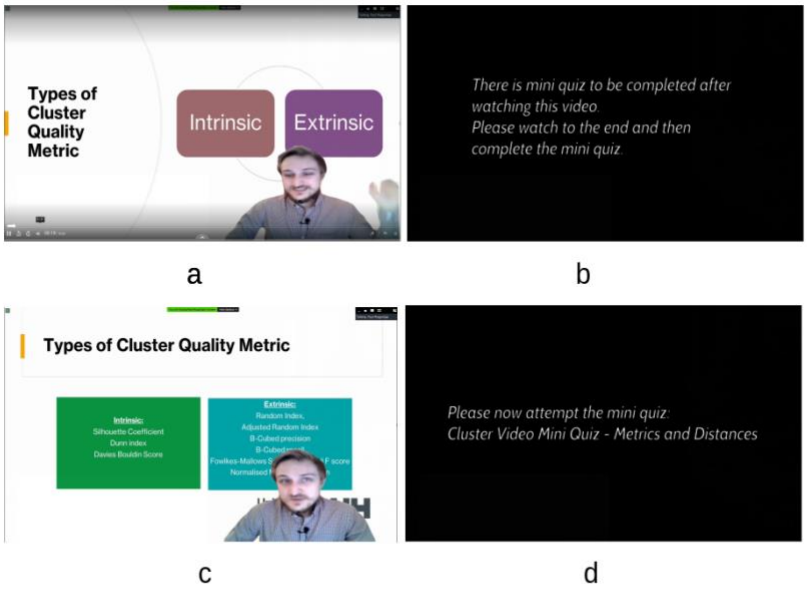

Figure 4 – a. the video is introduced, b. a message to draw attention to the presence of the quiz, c. the video continues as normal, d. a reminder to complete the quiz before the video fades to black.

Regarding both videos with text-based instructions “Clustering Introduction”, “Clustering Metrics and Distances” and “Clustering with K-Means”, in hindsight, reading the message would have increased accessibility.

Table 1 - a table showing the changed features of the videos, included the two improvements to the videos, the mini quiz and quiz creation. Note the that the two original videos have been divided up into shorter videos.

Original video title	New video title	Lecture Presence via Greenscreen	Runtime (mins: secs)	Guidance to Reading	Virtual Whiteboard	Mini Quiz	Quiz Question Creation
Classification (approx. 45mins)	Introduction to Classification	X	11:10				
	Information Gain Decision Tree	X	11:30		X		
	Naive Bayes	X	8:23				
	Linear Regression	X	6:45				

	Improving Classification Accuracy	X	7:57	X			
Clustering (approx. 45 mins)	Clustering Introduction	X	12:39				X
	Clustering Metrics (and Distances)	X	19:25			X	
	Clustering with K-Means	X	12:49	X		X	

At the end of the unit Classification and Clustering the students were presented with an anonymous survey asking about the videos, seen in Figure 5. The survey used Likert scales and the order of the questions was randomised.

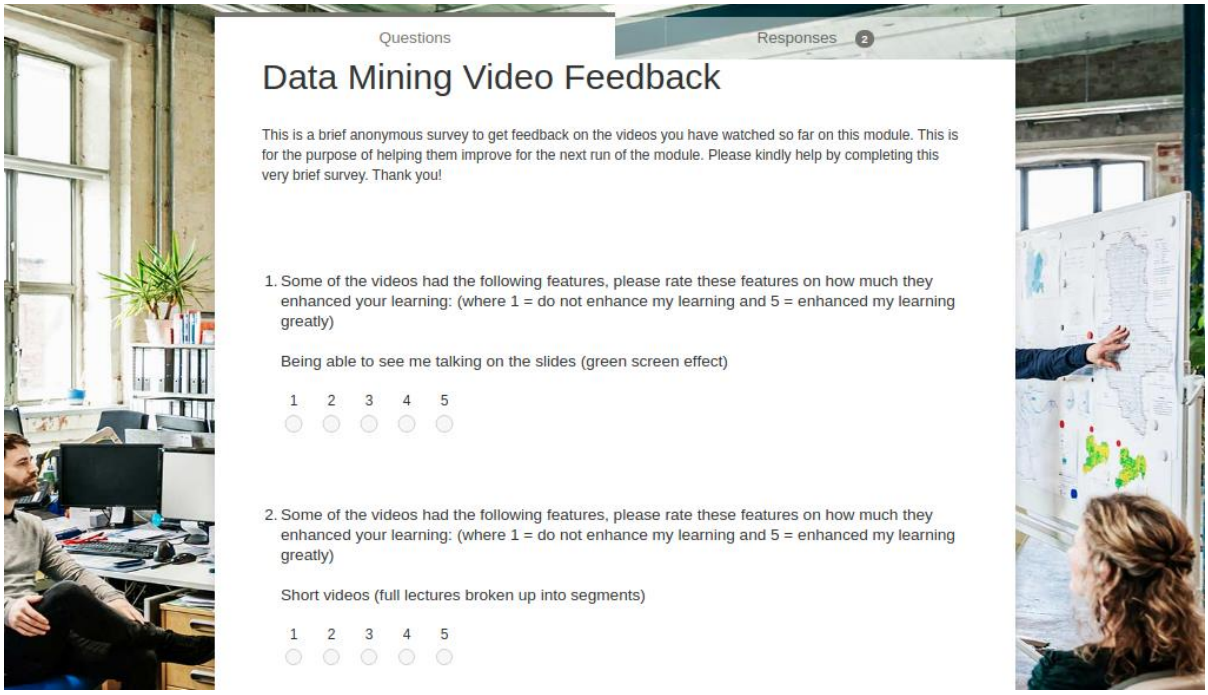

Figure 5 - a screenshot of video feedback survey the Data Mining students were asked to complete.

Results

The survey results are of limited use since only 6 out of 250 students responded. Figure 6 shows the data. Regarding the result for captions, it makes sense that this cohort of students would benefit from captions, with the vast majority speaking English as a second language.

The students did not feel the “Green screen” effect enhanced their learning the most. The green screen effect is to build a connection with the students, in line with the sense of belonging in our engagement models. The nor did the students feel the “Recommended

Reading" enhanced their learning the most. I feel this is because the students are very likely to be accessing digital copies of the books (especially at this pandemic time) and digital text can have barriers to reading especially were the technology used makes the experience less than slick (Rose, 2011).

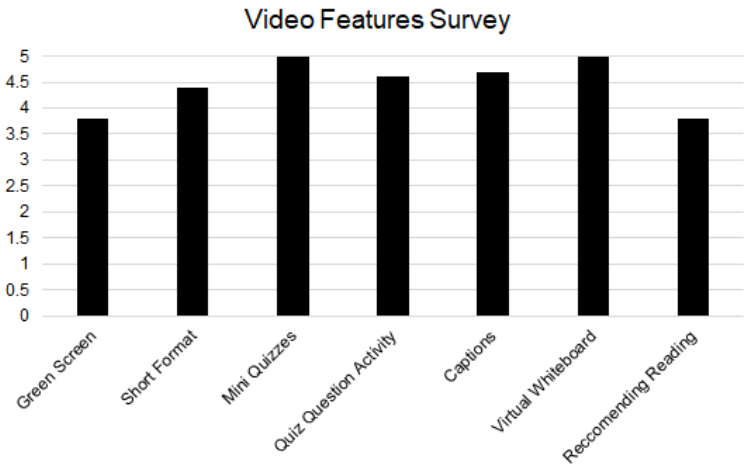

Figure 6 - The averages response of the students to the feedback survey asking about how the video feature enhanced their learning.

Next, we look at viewer retention. The individual plots for the new videos can be seen in the appendix of this paper. In Figure 7, a summarised view can be seen. To best capture the cases where the students were leaving the video due to the video itself, the viewers at the start were considered as the count of viewers at 1 minute into the video. The viewers at the end were considered as the highest amount within 1 minute of the end. This approach was chosen to avoid random artefacts, like auto play views (were the video plays itself, but the student has no intention of watching scroll/clicks away) and artefacts from the students leaving slightly before the end.

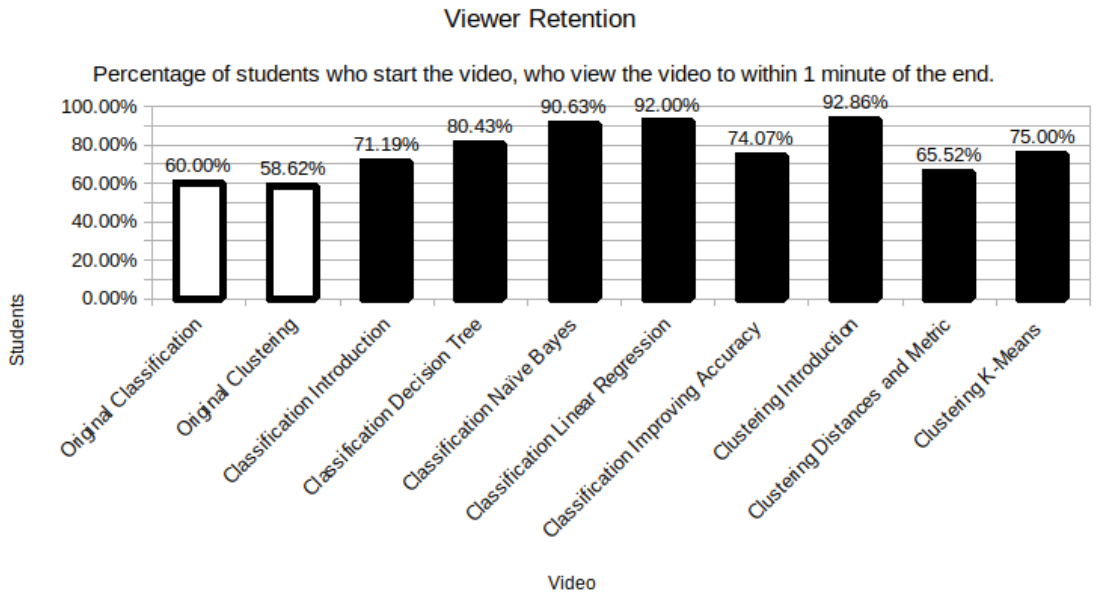

Figure 7 - The viewer retention for data mining videos, the original videos are shown in white and new videos in black. A clear improvement can be seen.

All the new videos ***individually*** received better viewer retention. The most successful video "Clustering Introduction" with a score of 92.86% featured the "Quiz Question Creation" activity. However, only 4 out of 250 students in total engaged with the activity. This suggests the reason for the increased viewer retention was not because of this. This hypothesis is supported by "Classification Naïve Bayes" and "Classification Linear Regression" scoring highly, 90.63% and 92% respectively, of which neither had an activity, despite my original hypothesis that the students liked collaborative and assessment focused activities.

A more fitting explanation for the increased viewer retention is segmentation of the videos. In Figure 8 the runtime is plotted against the retention. The Pearson's correlation coefficient between runtime and retention percentage as shown in Figure 8 is -0.77 indicating a strong negative correlation. The longer the video the less likely the students are to watch it to the end.

However, when you consider the new videos ***collectively*** the result is not so positive. When comparing the count of viewers at the start of the first new video with the end of the last new video, we can see the retention is in fact worse. The original (unsegmented) classification video retained 60% of video, however, the new segmented version only retained 31.75% across all the videos. Similarly, the original clustering video achieved 58.62% retention, however the new segmented version only retained 51.72% of viewers. It appears that students are lost *between* the videos. However, a confounding variable is that, unlike the original run (Semester A) of the module (where the classification video was uploaded in week 1 and clustering video was uploaded in week 6) the new videos were all

uploaded in week 2, effectively doubling the content the students had to watch in one week, this could have negatively impacted the results.

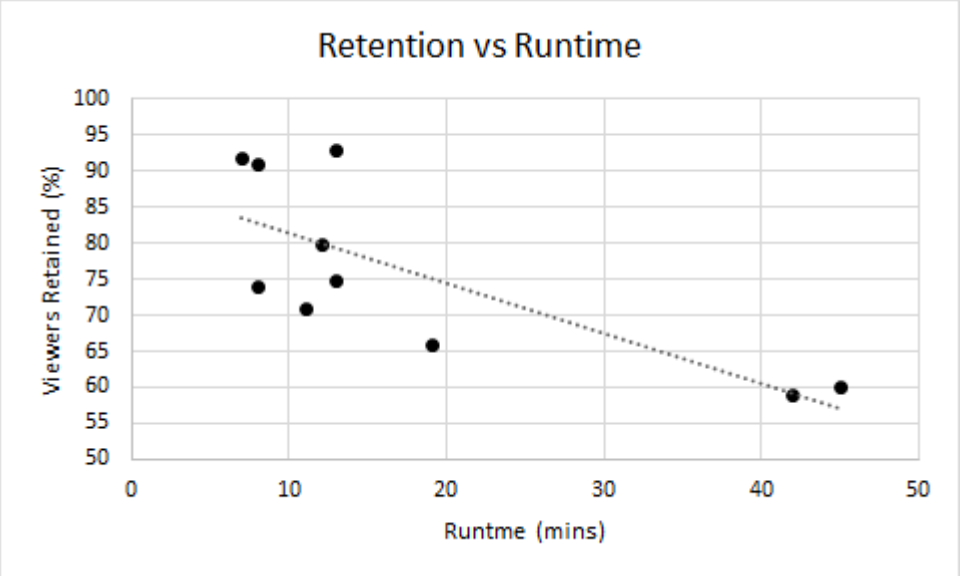

Figure 8 - Viewer retained vs. runtime, showing a negative correlation

Another confounding variable could be the differing backdrop of the pandemic which was escalating during the Semester A run with commencement of the second UK lockdown. While the Semester B run was released with the backdrop of cases reducing.

"Clustering Distances and Metrics" and "Clustering K-Means" contained the mini quizzes. Their lower retention could be due them being the last video in the list and therefore are subject to a student fatigue effect. The quizzes attached to the "Clustering Distances and Metrics" and "Clustering K-Means" videos, received 18 participants with an average score of 79% and 22 participants with an average score of 72%[2]. In this case, both quizzes have a good average score. However, if any of the students had performed poorly this could have indicated issues to be addressed at content or student level. At the time of writing, the students are yet to take the end of module summative tests and it will be interesting to see if formative quizzes prove to be predictor of summative performance.

Further Work

The formative quizzes and quiz question creation activity did not see good uptake and the videos they were attached to did not seem to benefit. We think there are two different routes we could take address this. Firstly, we could try an extrinsic approach to improving

[2] A couple of students clicked through the quizzes not answering the questions, completing the test with a score of 0 likely to see all the feedback comments. These bought the average down somewhat.

the quizzes and or videos, offering credit-based incentives for watching/completing the video/quizzes, research shows (Kibble, 2007) and personal experience indicates this would increase participation with the quizzes. While participation is not full engagement as per the model of engagement we are considering, by requiring the students to use the active recall paradigm, students participating sensibly in the quiz should benefit. Secondly, we could try an intrinsic approach to improvements, increasing the engagement through moving towards the deeper gamification engagement dimensions, through making the quiz more immersive. We could do this through selecting or creating a more fun way of presenting the questions. Available technology allows the questions to be built into the video itself, using this combined with the video presenting scenarios could produce an authentic and engaging experience for the students. The video could walk through scenarios at work and pause automatically at points to ask questions. Additionally, a social element / competitive element could be introduced, in line with both Whitton and Moseley's and Redmond's social dimensions.

Conclusion

This paper set out with the goal to increase viewership of recorded sessions using formative quizzes. However, participation in the quizzes proved poor and there their impact on viewership not certain.

An unintended outcome was that breaking videos up did increase viewer engagement per video, but more work was needed since overall viewer engagement overall the videos was not improved, indicating that breaking up videos is not enough, the video possibly needs to be re-recorded in a more concise format or supported interactive online content to maintain engagement between videos.

Concluding the work through Whitton and Mosley's Model of Engagement. We have found that to engage students through gamification you need to do more than focus on a providing isolated examples of gamification which do not align with all the dimensions. In the future work we propose two approaches which could be combined to fully motivate and immerse the students to lead to high engagement.

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Appendix

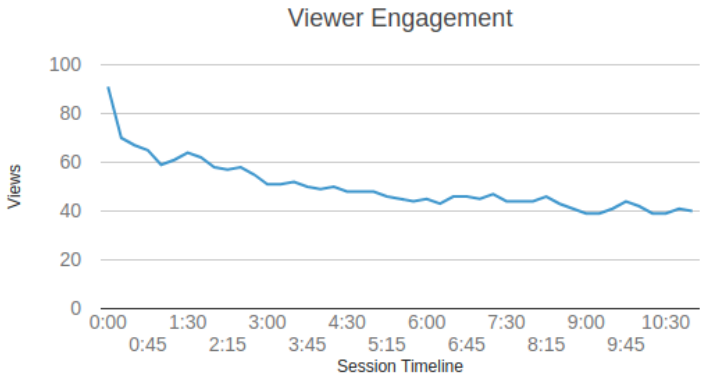

Figure 9 - Classification Introduction video viewer engagement

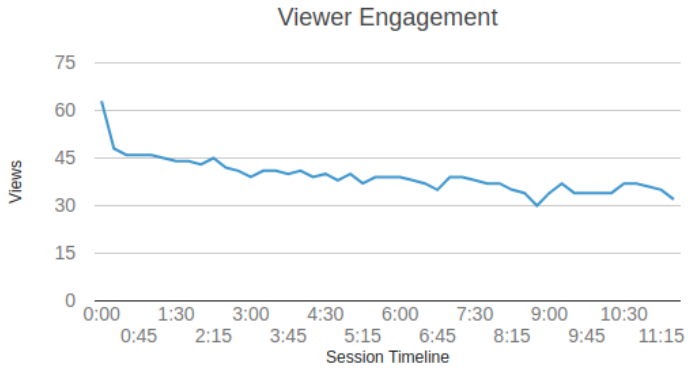

Figure 10 - Classification Decision Tree video viewer engagement

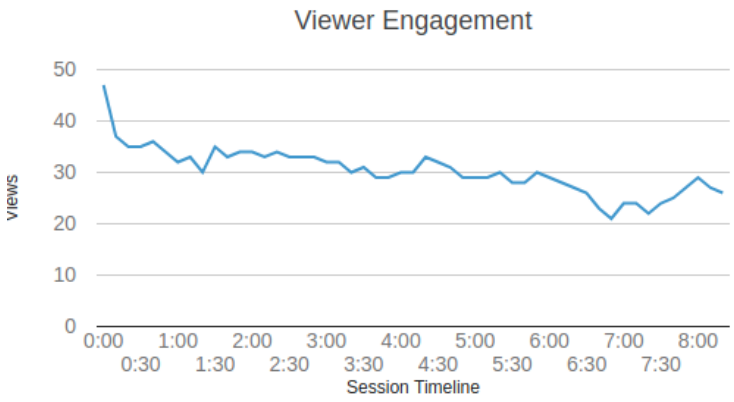

Figure 11 - Classification Naïve Bayes video viewer engagement

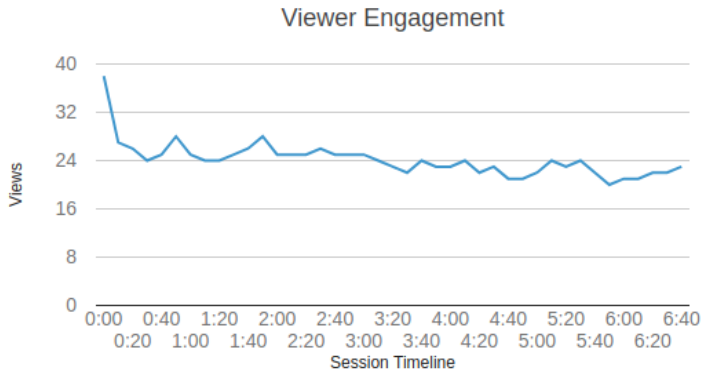

Figure 12 - Classification Linear Regression video viewer engagement

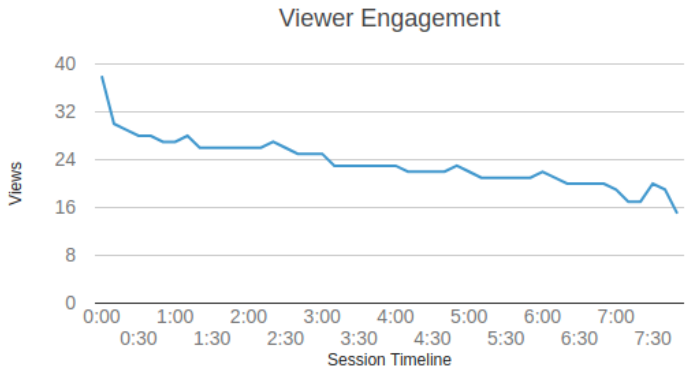

Figure 13 - Classification Improving Accuracy video viewer engagement

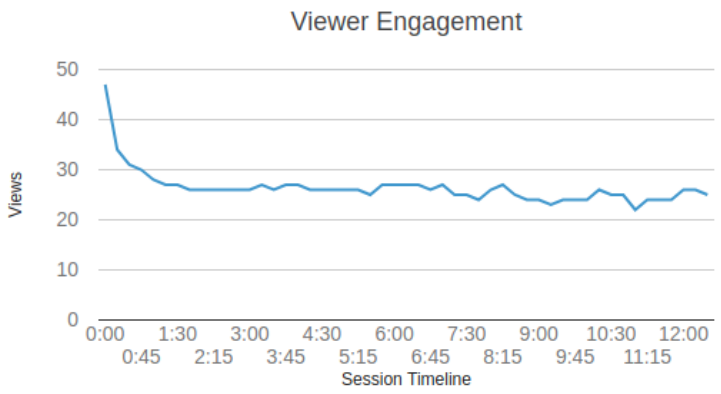

Figure 14 - Clustering Introduction video engagement

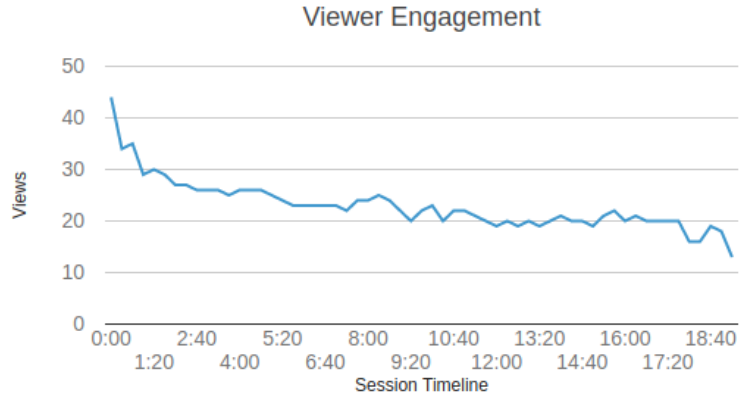

Figure 15 - Clustering Distances and Metric video viewer engagement

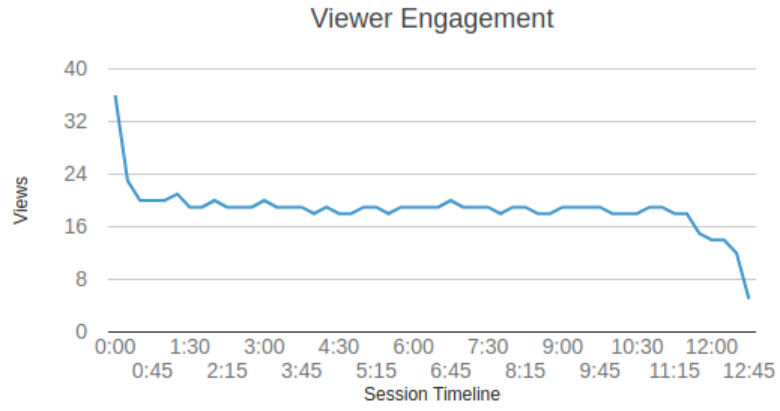

Figure 16 - Clustering K-Means video viewer engagement

Clustering Metrics and Distances Quiz Questions	Clustering K-Means Quiz Questions
What type of clustering quality metric is the Silhouette Coefficient?	What is the mean (average) of 1, 8, 2, 3? (Bonus points for doing not using a calculator!)
Distance metrics such as Euclidean distance follow certain rules which of the options is a correct rule?	What is Euclidean distance between p and q? p = [2, 8, 6] q = [1, 7, 4]
True or False, Manhattan Distance between (1,2) and (3,5) is 3.867	What is the k value in k-means?
When comparing binary variables, the Jacquard Coefficient takes negative-negative matches into consideration? True or False?	What is it called when the k-means centroids stop moving?

Table 2 - the questions in the mini quizzes for the two clustering videos. All questions were multiple choice, apart from the first two questions of the K-means quiz. Shown here in italics.

Transition into Higher Education within STEM: Recommendations for Effective Personal Tutoring at the University of Hertfordshire

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Abstract

Navigating the transition from prospective student to functioning practitioner is a daunting challenge. A first-year undergraduate is faced with the task of integrating and succeeding within a cohort of diverse educational and cultural backgrounds, something that research has shown can have a detrimental impact on the wellbeing of engineering students. The aim of the present research is to explore the transition of Level 4 Engineering students into higher education at the University of Hertfordshire and the role of the personal tutor in simplifying this process. It is proposed that giving students agency to interact with their peers, challenge assumptions and conduct sense-making early within their academic careers would help facilitate their transition into higher education. The nature of a personal tutor group provides a convenient environment in which to promote empathetic engagement and to develop self-understanding amongst first-year engineers through problem-based activities, ideally within the authentic context of real engineering problems. The paradigm of 'inclusive design practice' is proposed as a useful framework in which to conduct this work and to promote compassion-focussed pedagogy within the engineering curriculum. The integration of authentic assessment activities within personal tutor sessions that combine successfully with the wider assessment landscape presents a future challenge.

Introduction

The first year of undergraduate study is widely cited to be the most challenging in terms of retention and success for Science, Technology, Engineering and Mathematics (STEM) students (Hulme and De Wilde, 2014). While the start of university life is often regarded by students as a defining new era in their lives (particularly from a sociocultural standpoint), from the pedagogic perspective transition to higher education is better described as a continuing step in the much longer student journey.

Lochtie et al. (2018) suggest that the academic profession is becoming ever more complex with students entering higher education from increasingly diverse backgrounds. A personal tutor holds a position of great importance in this context; although the educational journey for many undergraduate students begins long before university and may continue beyond the completion of formal study, the entry point into higher education is a critical moment of sociocultural transition that can made easier through effective personal tutoring.

The aim of this research is to explore the transition of Level 4 Engineering students into higher education at the University of Hertfordshire and the role of the personal tutor in simplifying this process. In order to critically reflect on the role of a personal tutor as part of this transition process, it is first necessary to unpack the challenges associated with transition into higher education and to explore how these might be addressed. This has been conducted through a Literature Review that is limited in scope to STEM subjects and subsequently narrowed to focus on engineering students.

The Literature Review is presented in two complementary segments. The first segment attempts to characterise the transition into higher education through a survey of pedagogic literature relating to STEM transition, and accounts for some of the different pre-tertiary pathways that converge at point of entry to STEM study and give rise to skills deficits amongst Level 4 students. The second segment focusses on the apparent needs of nascent engineering students, including factors that contribute to the mental wellbeing of students and support mechanisms that contribute to student success and retention. Methods by which universities have been noted to promote or impede development of these factors are also discussed. The influence of wider educational policy and/or varying institutional approach to higher education transition is not explored as part of this work.

Literature Review

Characterising the Transition into Higher Education within STEM

In 2014, the Higher Education Academy (HEA) ran the 'Tackling Transition in STEM Disciplines' project, engaging delegates across STEM disciplines to better understand the issues faced by students entering STEM courses within higher education. The HEA report identified a consistent skills gap across STEM first-year undergraduates that left students under-prepared for tertiary education, including a lack of practical, writing, time-management, critical thinking, and independent learning skills (Hulme and De Wilde, 2014). While it might be convenient to disregard these shortcomings as the result of a 'deficit model' of learning (Wallace, 2015), exploring the root of this skills gap could help to address deficiencies by supporting students in becoming independent learners, and thereby creating learners who can construct knowledge within their own disciplines (Wingate, 2007).

Yorke and Longden (2008) argued that a mismatch in teaching styles between the pre-tertiary sector (i.e., directed, strategic, rote learning in smaller groups) and the higher education section (i.e., deeper, intrinsically motivated independent learning in larger groups) was a key contributor to any skills gap within first-year undergraduate cohorts. The authors also claim that students should be engaged in academic work and given formative feedback early after entry to help address these shortfalls. Yorke and Longden (2008) further state that teaching approaches should be focussed on student development within the subject area concerned, and priority should be given to methods that enhance the chances of students developing a network of peers that can support them in times of

difficulty. These findings resonate with the HEA recommendations, which call for adapted teaching methods within first-year undergraduate programmes to incorporate more scaffolded learning opportunities (Hulme and De Wilde, 2014), and suggest that the incorporation of peer-assisted learning and problem-based learning could be beneficial for supporting the transition of students into STEM disciplines.

The differences in teaching and learning styles across pre-tertiary environments can also have a profound effect on the ability of a STEM student to navigate the transition into higher education. The 'Transforming Transitions' project conducted interviews with first-year higher education/second-year further education students to better understand the differential outcomes in terms of success and retention of BTEC students compared to A-Level students (Myhill, 2020). As summarised by Huskinson et al. (2020), key challenges identified from this project included:

- Academic under-preparedness
- The awareness (but under-utilisation) of academic tutoring
- Becoming an independent learner
- Developing a 'sense of belonging' at university

As well as signalling the presence of the academic tutor within the pre-tertiary to higher education 'transition landscape', the summary presented by Huskinson et al. (2020) also provided important direction for the present research. For example, a key question that requires further exploration is whether the challenges of becoming an independent learner and developing a sense of belonging at university intersect with the role of the personal tutor? If so, in what ways?

Developing Independent Learners Who Belong

Research has shown that student wellbeing has a decisive role to play in a student becoming an independent, 'self-actualised' learner (Deziel et al., 2013). Assessing the mental health of engineering students across a large Canadian university, Deziel et al. (2013) showed that that first- and final-year students had lower mental health scores than peers in their second year of study (with second-year students found to have the highest overall scores and first-year students the lowest overall scores). First-year students were also found to encounter multiple distinct challenges, including separation from friends and family, a change in lifestyle associated with a move to a new city/place of study, and increased workload (Deziel et al. 2013). In contrast, the authors also found second-year students were 'more relaxed' due to the reduction in weekly evaluations and low number of homework hours, with a lesser focus on the 'fear of failure' noted as being a large stress reducer (Deziel et al. 2013).

Interesting relationships were also discovered between the academic influences on mental health scores and the mental health indicator 'self-actualisation' (i.e., the ability to recognise one's abilities and the process of this recognition) (Deziel et al. 2013). The number of hours spent in classes (with little room for independent thinking) was found to have negative impact on self-actualisation across all programmes, whereas the number of 'self-motivated' homework hours was found to have a positive impact (Deziel et al. 2013). These findings share common ground with some of the resistive factors and recommendations identified as part of the transition of STEM students into higher education, particularly with regard the need to develop 'self-actualisation' early in the university journey (Yorke and Longden, 2008).

An important mechanism through which students achieve a deeper understanding of their place within the university environment is their interaction with peers and university staff. As part of the 'Transforming Transitions' project, Huskinson et al (2020) stated that students gave positive feedback regarding physical, 'people-based' resources, suggesting that meaningful interactions can help to nurture a sense of belonging and in turn raise student confidence (increasing their chances of success and retention). Similarly, Herbert and Mackenzie (2019) suggested that academic tutoring provides an opportunity to meaningfully interact with students, and that lecturers would benefit from guidance to improve the overall tutoring experience.

Engaging with empathy is a factor cited by Walther et al. (2020) that could help to engage students during their transition process. The authors suggest that empathy makes visible (and pedagogically accessible) students' value orientations that frame their relationships towards others and their self-understanding as engineers, and that empathy development is an integral core of being an engineer in the 21st century. The discussion of empathy often presents an uncomfortable implication for STEM pedagogy, where the pedagogic focus is mostly centred on rational learning. Walther et al. (2020) make clear that discussion of emotion in an engineering classroom is an unusual and unfamiliar topic for both student and educator alike, however there are potential benefits to adopting such an approach. For example, Gilbert (2016) found that by embedding a compassion-focussed pedagogy within seminar sessions, students became attitudinally inclined to increase efforts over time to enhance the social learning experiences of themselves and their peers.

A further benefit of developing a strong sense of belonging amongst undergraduates is to accelerate the development of a professional identity. The transition from student to 'STEM professional' can be viewed as a shift in how students participate in professional practices, in accordance with the 'communities of practice' philosophy proposed by Wenger (1998). To facilitate this process as part of a compassion-focussed pedagogy, Paguyo et al. (2015) sought to incorporate innovative curriculum activities that demonstrate how the engineering profession benefits from diversity. Moreover, Page (2011), proposed that engineering practice is strengthened through both demographic and identity diversity as

well as intellectual and cognitive diversity, thus reflecting different ways of depicting situations or developing solutions to problems. These findings provide an important link to the work of Walther et al. (2020), who demonstrated that students often enrol onto an engineering degree programme with pre-conceived ideas about engineers and the engineering profession, some of which may be inaccurate. Engaging in emotional learning and cherishing diversity in teaching can assist in removing misconceptions about what engineering is and should be. Such misconceptions are extremely damaging and may prevent engineering students from developing the skills and orientations required to engage in the tensions and nuances of modern engineering work (Jonassen et al., 2006).

Stevens et al. (2008) contend that the notion of an engineering identity is two-sided; it is both how a person identifies themselves and how others identify the person in different contexts. This duality suggests that teachers and peers must work to identify students as engineers to foster this identity within the student. To help develop a professional identity, Eliot and Turns (2011) proposed three main processes that must occur: doing (learning engineering skills and knowledge); interacting (identities are formed as we position/identify ourselves within a group and are identified/positioned by others); and sense-making (developing a personal narrative detailing identity and fit).

The ability to develop inclusive identities must be balanced against unwritten, unofficial, and often unintended lessons, values and perspectives made by individuals within an academic environment, often referred to as the 'hidden curriculum' (Villanueva et al., 2018). In the classroom, relationships are integral to the learning and socialisation process of students and their instructors (Michael, 2015). However, since higher education literature tends to describe engineering education in rational terms that exclude constructs such as affect, emotion and motivation (Matusovich et al., 2013; Hilpert et al., 2014), the prevalent hidden curriculum in engineering is to assume that emotion is not an important construct within the classroom (Hargreaves, 2003). Villanueva et al. (2018) contend that self-efficacy (the ability to execute control over motivation, behaviour and social environment) is an important regulatory tool for the management of challenges and setbacks and that the development of this quality in engineering students is vitally important; without self-efficacy, self-advocacy (the desire/willingness to hear previously unheard voices/perspectives and advocate in favour of these) against the hidden curriculum becomes increasingly difficult.

A summary of key findings from the Literature Review is presented in Figure 1.

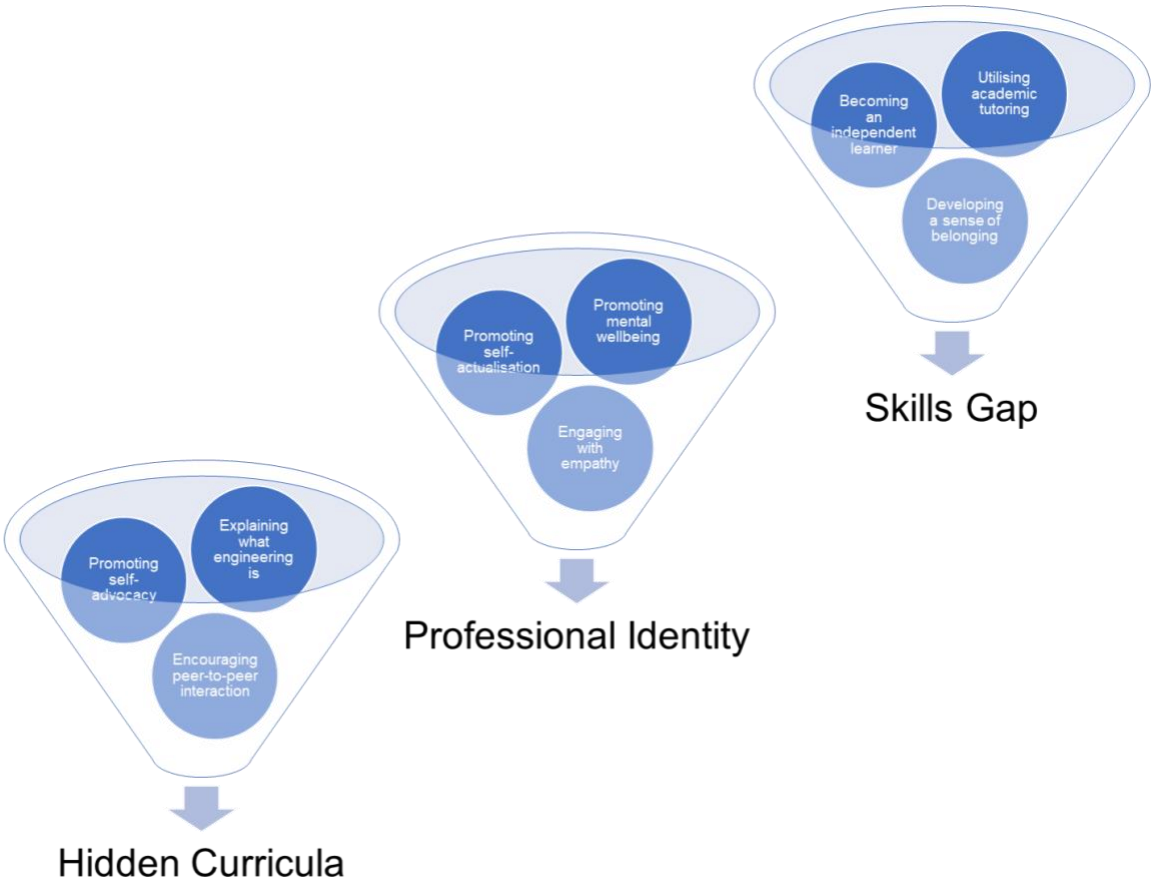

Figure 1: Targets for addressing the skills gap identified amongst first-year engineering undergraduate students

Each 'basket' in Figure 1 represents a broad target that must be eliminated in order to facilitate transition into STEM higher education, i.e., to *expose hidden curricula*, *develop professional engineering identities*, *address the skills gap*. The baskets indicate an approximate pathway towards reducing the skills gap amongst first-year engineering undergraduate students and contain a subset of objectives that represent progress towards each individual target.

Critical Reflection

Following identification of the key targets to facilitate student transition into STEM higher education, critical reflection was conducted using the four lenses proposed by Stephen Brookfield (Brookfield, 1995). The subsequent interaction between theory and practice is presented within the reflective model proposed by Rolfe et al. (2001).

The Autobiographical Lens ("What?")

The challenges faced by first-year STEM undergraduates upon entering higher education have formed the analytical focus for this paper. As a personal tutor, I too have felt under-prepared to appropriately meet this challenge; I have yet to receive a clear definition of

what a personal tutor session should look like, how it should 'feel' or what a personal tutor should 'be' to their students. Consequently, I feel driven to better understand this challenge such that I can properly utilise personal tutor sessions to facilitate a smooth transition into the university environment for my tutees.

Reflecting on my own experience of transition into higher education as a white, British student that entered higher education through a 'conventional' A-Level pathway, my criteria for belonging within the university environment was to pass examinations. I earned my place as an undergraduate student after I had passed my first-year exams and any additional qualification of my place at university was simply non-existent. As an academic however, I now understand that there are many additional pressures and barriers that impede the progress of undergraduates that may have arrived at university from one of many different pathways. For any student that has spent adolescence developing within a community of like-minded cultural peers, to be asked to flourish within a new environment populated by diverse cultures, opinions and ways of thinking is a daunting prospect that is deserving of support.

The Student, Colleague and Pedagogic Lenses ("So What?")

Overcoming the skills gap outlined for STEM undergraduates is a key target for improving success and retention within higher education. It is important to note here that challenges around academic under-preparedness are already being addressed at the University of Hertfordshire, for example through academic support services including Academic English and Study Skills Development, the Maths Support Service and Library SkillUP pages.

The focus of this reflection therefore falls on the development of other skills, such as developing a 'sense of belonging' at university. My Level 4 tutor group consists mainly of students that have arrived at university from a variety of entry modes (e.g., vocational courses) and that, as a result of the COVID-19 pandemic, are studying remotely from outside of the United Kingdom. Fortnightly personal tutor sessions have gradually diminished from being well-attended at the start of term to being attended by just a single international student. When the student was asked why they kept up their attendance of the session, the student responded that they found value in 'keeping in touch with the university' while abroad and that the personal tutor session was a way of achieving this; such one-to-one interaction is rarely attainable through classroom activity (especially in the online environment).

This feedback is reflective of the results published by Hulme and De Wilde (2014), where students gave positive feedback regarding physical, 'people-based' resources that promoted meaningful interactions. Despite on-going support received from Hertfordshire International College, the international student also commented that facilitating meaningful communication outside of electronic means would be beneficial to them; experiences where the student had to self-guide within the university support system led them to call for

better signposting of support resources and more efficient communication. I have learned that a personal tutor has a key role to play in this regard.

It is also important to explore the notion of wider student wellbeing in this context. Deziel et al. (2013) showed that first-year engineering cohorts display disproportionally lower mental wellbeing compared to other cohorts, but that cohesion amongst classmates and the ability to focus on areas of interest or fulfilling, real-world engineering applications can help to bolster mental health. I have previously been approached by a Level 4 tutee who was struggling with assessment-related anxiety, where fear of failure and coping with the unfamiliar landscape of online assessment were cited as strong drivers of their unease. I felt fortunate to have been deemed trustworthy of the student's confidence but also a weight of responsibility to assist them. Drawing on similar feelings of anxiety and 'fear of failure' from my undergraduate degree, I was able to engage in conversation with the student and direct them to the professional support offered by the Student Wellbeing service. Further, I believe my experiences as a learner on the CPAD programme helped me to visualise the difficulties that the student was facing from their perspective.

I am pleased to say that having received additional support from Student Wellbeing, the student was recently credited as a member of a UH team that secured the University's best-ever finish in the IMechE Design Challenge for first-year engineers within the Greater London area. It is interesting to note that this student was also one of the most regular attendees of the personal tutor sessions and appeared to enjoy the opportunity to share their feelings and experiences within our small community of practice; through engaging with the community, this student seems to have found success and developed a sense of belonging at university.

In addition to the conclusions regarding student wellbeing of Deziel et al. (2013), my experiences intersect strongly with the findings of Wenger (1998), Paguyo et al. (2015) and Page (2011). The transition from student to 'professional engineer' can be viewed as a shift in how students participate in engineering practices; the earlier a student participates in these practices, the more quickly they develop necessary skills in self-actualisation to move towards becoming an independent learner.

I feel therefore that it is incumbent upon both educational institutions and individual educators to provide students with opportunities to participate in engineering practices, and particularly so for first-year undergraduates. The personal tutor framework presents an important mechanism for the university to facilitate such opportunities and to form a 'safe space' within which students can have their perceptions widened and challenged (Jonassen et al., 2006), develop professional identities (Eliot and Turns, 2011), form a supportive network of peers, and receive formative feedback early after entry into higher education (Yorke and Longden, 2008).

Teachers must participate in these processes in meaningful ways and identify students as engineers to foster this identity within the student. However, to build truly meaningful learning relationships educators must also seek out and expose hidden curricula. Where there is a lack of engagement, it is sometimes difficult to know how much agency to place with the student to conduct this process. As a personal tutor I often find myself scrambling for meaningful discussion points with my tutees, and a failure to identify these has resulted in listless, directionless personal tutor sessions (with a consequent negative impact on attendance). As part of the CPAD 'Swapshop' exercise, academic colleagues have also offered their experience of personal tutoring within their discipline. An interesting viewpoint was expressed by a colleague from psychology, where focussing on 'what was left unsaid' during small group discussion was found to be a useful method for exposing hidden curricula and the tacit knowledge of the tutor. If awkward silence can be overcome, speaking less can facilitate more meaningful interaction with students.

From the student perspective, it is clearly difficult to make meaningful engagement in online meetings. In my experience, the overwhelming preference has been for student video cameras to be switched off and for intra-class communication to take place via text-based chat. This presents a challenge for the tutor and students alike, and jars with the results of Gilbert (2016) who state that students have found eye contact to be critical in mediating the spread of participation within seminars.

Further Work ("Now What?")

It is proposed that scaffolded, problem-based activities through the integration of 'real' engineering problems would provide a useful avenue for increasing student motivation. Framing these activities within the paradigm of 'inclusive design' would make these recommendations pedagogically viable (i.e., engaging with empathy, promoting self-efficacy, developing a sense of belonging, and exposing hidden curricula).

Brookfield (1995) made helpful recommendations on the use of 'inclusive teaching' and 'discussion as a way of teaching' that would be relevant in this context. The utilisation of inclusive content (consulting multiple perspectives), inclusive practice (utilising multiple modalities/settings), and inclusionary leadership (building community responsibility, creating avenues for anonymous feedback) might be conveniently accommodated by a fortnightly personal tutor group session for which students could conduct pre-class preparation, in-class activities, and post-class consolidation. This approach may also help to embed compassion-focussed pedagogy within the engineering curriculum through facilitating group work and improving student perceptions around groupwork and learning from their peers.

Success at university is dependent on the use of critical thinking and critical reflective thinking; we must therefore give students the opportunity to develop these skills if they are to flourish within an academic environment. The challenge is to encourage students to make

their thinking explicit through teaching criticality and utilising authentic assessments to replicate future experiences (e.g., dialogic, formative or low-stakes summative assessment measured against student-centred learning outcomes). How these activities integrate within the broader assessment landscape (e.g., across a programme of study) and are made achievable for all members of academic staff is currently unclear.

Summary Recommendations

Summary recommendations relating to key challenges highlighted by the Literature Review are presented below. It is hoped that these short notes may be useful in stimulating and guiding further discussion over the future role of the personal tutor at the University of Hertfordshire.

Exposing Hidden Curricula

- Shivers-McNair et al. (2018) recommend creating a safe space for students to offer constructive feedback to their instructor. Facilitating a safe, creative environment in which to work not only encourages innovation through creativity and without fear of judgement, but also leads students to become better problem solvers through design thinking.
- Inclusive design is about making places that everyone can use through the removal of barriers that create undue effort and separation (CABE, 2006), and is pursued through five principles:
    a. Put people at the heart of the design process
    b. Acknowledge diversity and difference (identify barriers to inclusion and remove them as early as possible in the design process)
    c. Offer choice where an exclusive solution is unavailable
    d. Provide for flexibility in use
    e. Solutions are convenient and enjoyable for everyone, including intellectual and emotional access
- These principles apply as much to the design process as to the object of the process; the aim is that users and other potential consumers should be involved early in the design cycle and regularly consulted throughout the design process. This process could be used as a proxy for exposing hidden curricula amongst first-year engineering students.

Developing Professional Identities

- The context in which learning takes place is important to its meaning; evaluating the impact of professional practice on society can be used to give meaning to an otherwise rational, emotionless engineering pedagogy.
- Experiencing empathy in the engineering context and reflecting on those experiences prompts students to engage with fundamental aspects of their own professional formation (Walther et al., 2020). This helps to develop a sense of belonging and promote sense-making.
- Exploring 'inclusive design' can also provide principles for designing and redesigning pedagogy; adopting a user-centred approach makes room for self-development and reflection among students and teaching staff (Shivers-McNair et al., 2018).
- As well as enhancing engagement with creativity and empathy, learning experiences must remain authentic, i.e., design problems should be based on real-world problems to be meaningful to students (Nicholl et al., 2016).

Addressing the Skills Gap

- Adapt first-year undergraduate programmes to incorporate scaffolded learning opportunities early within the STEM undergraduate experience, including peer-assisted learning and problem-based learning. This would help to bridge the gap between different teaching and learning styles either side of the entry point to higher education.
- Problem-based activities increase student motivation through the integration of 'real' problems (Savin-Baden, 2004). This also helps to develop technical know-how while simultaneously demonstrating engineering to be a creative, interdisciplinary, inclusive activity.
- Active learning approaches can feel unstructured and chaotic (Royal Academy of Engineering, 2018); situating them within a scaffolded, small group setting may help to negate this aspect.
- Leverage the virtual learning environment to give Level 4 students agency to engage with and guide their learning experience; students often find innovative ways of navigating online resources to help reinforce peer-assisted learning and the 'flipped classroom' (Lage, Platt and Treglia, 2000).

Conclusion

This research has explored various challenges experienced by STEM undergraduate students in making the transition into higher education and the role of the personal tutor within this

process. A review of pedagogic literature has been presented that characterises the difficulties associated with undergraduate on-boarding, highlighting multi-faceted challenges including academic under-preparedness, under-utilisation of academic tutoring/pastoral care, becoming an independent learner and developing a sense of belonging at university.

While academic under-preparedness is already being addressed at the University of Hertfordshire, there remains scope to develop the role of personal tutor away from being a 'point-of-contact' towards a key stakeholder in the development of independent learning skills and fostering a sense of belonging amongst first-year undergraduates. It is proposed that giving students agency to interact with their peers, challenge assumptions and conduct sense-making early within their academic careers would help students to achieve these objectives, ideally within the authentic context of real engineering problems. The small size and pastoral nature of a personal tutor group provides an established, safe environment in which to promote empathetic engagement and to develop self-understanding amongst first-year engineers through problem-based activities.

The paradigm of 'inclusive design practice' is proposed as a useful framework in which to conduct this work and to promote compassion-focussed pedagogy within the engineering curriculum. However, the integration of authentic assessment activities within personal tutor sessions that fit within the wider assessment landscape presents a future challenge.

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