Please don't put your phones away: the application of learning technology in United Kingdom higher education and a framework for implementation

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Abstract

The aim of this research is to identify best practice when adopting new learning technologies in United Kingdom (UK) higher education (HE). Although technology is widely used within institutions and often has a positive impact on the learning experiences of students, there is only limited research designed to help lecturers with its implementation in the classroom. This research presents a critical review and assessment of some of the practices being incorporated in HE teaching, learning from the experiences of both students and lecturers. This paper presents the outcome of two case studies of Tophat and Socrative learning technology tools used in the classroom; the findings highlight challenges and identify best practice. Based on the case studies and the critical review of other, similar research, a 'Learning Technology Conceptual Implementation Framework' has been developed; this offers guidance on the implementation of learning technology in the classroom.

Keywords: higher education; best practice; Tophat; Socrative; Learning Technology Conceptual Implementation Framework

Background to the use of learning technology in higher education

The use, during the last decade, of learning technology as an aid to teaching and learning in higher education (HE) has become both accepted and in many ways, expected (McKnight *et al*., 2016). Its many benefits, particularly in terms of interaction between staff and students and the assessment of students' learning, have not been universal and, at times, its introduction has not seemed integral to an overall teaching plan; instead, the focus is on the technology rather than the learning experience as a whole. Consequently, it is still necessary both to share the views of the students and lecturers who have experienced these technologies in the classroom and to try to develop a higher degree of coherence in their use. This study presents a conceptual implementation framework (CIF) which has been developed on the basis of findings to a number of initial questions:

1. What are students' experiences of the use of learning technology in HE?
2. What are lecturers' experiences of the use of learning technology in HE?
3. What is best practice in the use of learning technology in HE?

Learning technology

While there have been many definitions of what is meant by 'learning technology', the definition that will be used in this paper is 'the application of technology for the enhancement of teaching, learning and assessment' (Rist and Hewer, 2019). Deployment of learning technology within an educational framework has accelerated in recent years, driven by the

belief that many current HE students are 'digital natives' (Prensky, 2001; Thompson, 2013). Though there is evidence to suggest that such a label is unhelpful and not reflective of the reality – that students' ability in this area varies according to their previous experiences (Johnson, 2015) – this has not prevented the wide adoption of mobile technologies – in particular, applications (apps) downloaded on mobile phones and tablets – as a learning tool in HE (McKnight *et al*., 2016). The belief is that students are able to engage in the learning process with their mobile phones, personal laptops or tablets (Osborne *et al.*, 2013; Pegrum *et al., 2013)*. To analyse the concept of digital natives a little more, there is a generally held assumption assumption that, as students are digital natives (Prensky, 2012), they will greet the introduction of new technology with enthusiasm and they will have the expertise to embrace this form of learning. Such erroneous notions have been challenged. Buckingham (2010) explains how digital literacy is about more than just knowing the processes – it is about the reified knowledge (Wenger, 1998) that accompanies a whole different way of interacting with digital technology. This point has been made most recently by Zhou and Wolstencroft (2020), who argue that belief in the homogeneity of the student group is an assumption that can hinder the development of digital literacy within the sector.

In addition to utilising technology that is well known to learners, the practice of including learning technologies within a lecture has altered the relationship between lecturers and students. The integration of mobile devices encourages learners who have traditionally been passive receptors of information to become self-regulating, active participants in the construction of knowledge (Abrami, 2001). Portable, personalised digital devices also contribute to connecting learners with their peers and lecturers in a 'learning hub' (Wong, 2012) where they can learn collaboratively. Norris and Soloway (2008) suggest that mobile devices – with their personal learning tools, resources and self-created artefacts – offer the potential for 'anywhere, anytime' creative and collaborative construction of knowledge, something which can help the learning process, changing it from the standard lecture model (Helfaya and O'Neill, 2018).

This transformation of the learning context may take many different forms; the 'flipped classroom' (Wanner and Palmer, 2015) is one such, in which the student is expected to take far more ownership of her/his learning and for preparing for the session. This way of learning fundamentally redefines the student-lecturer relationship and represents a shift of approach from pedagogy to andragogy (Knowles, 1984), with more emphasis on the students and an expectation that they will be self-actualising, active participants, not passive receivers.

Though many innovative tools and apps have been introduced to improve teaching and learning practices in the education sector, there is consensus that digital technology enhances students' engagement only if there is a clear purpose for its use (Borup e*t al.*, 2014; Sek *et al*., 2012; Zhou and Orim, 2015). An example of this would be research by Zhou and Orim (2015), who investigated the potential impact of the learning software 'Tophat' – which includes a student response function, attendance record and an online discussion forum – on engineering students' engagement and performance. Their findings suggest that using Tophat strengthens teaching practices by increasing interaction between lecturers and students inside and outside the classroom.

Other researchers have explored the influence of embedding technology in the assessment of students' engagement and performance. Sek *et al*. (2012) examined students' perception of technology in relation to self-test e-assessment systems. They discovered that the self-

test quiz tool could facilitate students' learning and provide formative feedback, but, again, only if there was a clear purpose to it. The key word here, as with much of the literature, is 'facilitate': the technology is being used to help the lesson and to improve relationships between lecturer and student, rather than being a focus in itself.
In addition to being a vehicle for teaching and learning, mobile technology has also been adopted to deliver feedback to students. Borup *et al*. (2014) examined the use of video feedback and its impact on blended courses. Their results showed that students felt positive about the use of video feedback as a conversational and interactive approach which connects instructor and students, a finding that has been replicated elsewhere (Wolstencroft and De Main, 2020).

Regardless of the use of mobile technology as an educational tool, concerns have been raised about the under-utilisation of devices in an educational environment. Mueller *et al*. (2012) carried out a pilot study on the use of mobile phones as an instructional tool with a group of business students. The findings from their study, while positive, did have a downside – they found that the most common use of phones in lessons was for communication between students, something that might well disrupt the learning process. This was corroborated by Waycott *et al.* (2010) and also by Wood *et al.* (2018), who listed a large number of examples of how technology might encourage off-task behaviour.

Finally, the use of learning technology without a clear purpose can alter students' perceptions of the learning process. The use of digital technology has the tendency to encourage students to look for one answer, rather than embrace broader concepts, and also lessens their ability to look critically at any information, for they instead become reliant on the device (Rowlands *et al*., 2008).

Returning to a key theme, the use of learning technology in HE is based upon the assumption that 'digital native' students are capable of processing and thinking through information by adopting digital language. Though there is certainly evidence that many expect this approach (Prensky, 2004), it is important to state again that we should not treat this group as a homogeneous mass, as, for some students, technology remains a challenge (Taylor, 2014).

Learning technology: the student view

When analysing the use of learning technology in UK HE, it is important to recognise the changing role of the student in the sector. Whereas, prior to the era of mass participation in the sector, students generally accepted what a university offered them, now they are often viewed – and may view themselves – as student-consumers (Tomlinson, 2017). This means that students' views are collected and disseminated to lecturers at regular intervals, leading to a culture in which the 'student experience' is at the heart of the learning process. In this culture, there is an 'expected' pattern of learning which often revolves around a formal lecture supplemented by seminars to explore information in greater depth and with more interaction. Given that research suggests that there is likely to be a correlation between exposure to technology in HE and academic achievement (Kirkwood and Price, 2014; Kong and Song, 2015; Venkatesh *et al.*, 2014), the push is to fit the technology into the framework that students expect. This also creates a change in the relationship between staff and students, which means that to look at it in isolation is difficult. Tomlinson very deliberately uses the word 'consumers' rather than 'customers' for students, as it relates to a service

rather than to a homogeneous product; however, the principles are still broadly compatible – the students' perception is that, as they are paying for something, they have the right to have a say in what is delivered.

While accepting the benefits of using learning technology, it is important to recognise that there are problems in its use. Given the potentially disruptive nature of mobile phones, it is not surprising that students have found difficulty completing activities and fulfilling the learning outcomes when they have engaged in multi-tasking using the same device, potentially with online social networking, messaging, discussion and interaction with other communication platforms going on in the same lesson (Junco and Cotton 2011; Selwyn, 2016). The key challenge is how to reduce possible disruption by personal devices of the learning process.

Learning technology: the lecturer view

In spite of some inevitable overlap between the views of lecturers and students, it is still important to look at and assess lecturers' views of digital technology: a similar story of benefits and potential problems emerges. Returning to another key theme, the integration of technology is seen as a factor that drives a successful lesson. Pegrum *et al*. (2013) talk about the need to integrate mobile devices into a broader learning ecology rather than merely to use them for the sake of using them – a commonly held view.

Another theme identified is that mobile devices can enhance student motivation (Kong and Song, 2015) and the increasing use in HE of 'bring your own device' (BYOD) as a prevalent e-Learning initiative (Al-Qahtani and Higgins, 2013; Pegrum *et al.*, 2013) helps to facilitate that. The shift in emphasis from the lecturer's providing new technology to the students' using their own technology means that pressure on lecturers is reduced and also that personal digital devices facilitate learners' attainment of intellectual, personal and social reflective engagement in HE (Kong and Song, 2015). This increased engagement has been mirrored in other studies (Pegrum *et al.*, 2013) and, when handled correctly, can promote learners' engagement in reflective inquiry for deep learning and personal growth.

Approaches that utilise BYOD technology can also influence assessment style and type, as well as the delivery timeframe. Wanner and Palmer (2015) explored students' and teachers' perceptions about flexible learning and assessment on a flipped university course. Findings from this research and others (Hwang *et al*., 2015) suggest that students enjoy their learning and are more engaged with it when learning in this manner. Students prefer their personalised learning both in the form of online activities and, predominantly, in interactive, collaborative, well-structured learning activities in a face-to-face environment with flexible assessment.

While accepting the benefits of utilising learning technology (via BYODs or other forms), it is important to restate the problems associated with their use in class. The list of off-task behaviours that can occur when students sense a lack of purpose in the use of learning technology (Wood *et al.,* 2018) suggests that it is vital for students to be made aware of why and how the technology is being used (Stephenson, 2018).

Case studies

This article is framed in a rather different way from many that cover similar topics. The main body consists of two case studies that the authors have undertaken. These will be used to inform a framework that can be used when applying digital technology to lessons. Both are from Business-related modules lasting eleven weeks and involve the introduction of learning technology in the classroom. The technologies chosen, Tophat and Socrative, were selected as they are relatively simple for both lecturers and students and are widely available. The findings are presented to the reader at the start of the section, with brief conclusions offered for each case study. Then follows general discussion about the themes identified and their connection to the literature, before the framework is introduced as a natural conclusion to the evidence produced.

Both quantitative and qualitative data has been collected from the case studies. In some cases, checks on data were carried out using university systems; so, for example, it was possible to see how many students logged into the system prior to the lesson. For the majority of information however, a survey of all students was carried out.

A further data collection method used was observation – very useful as a data collection method, for, if participants are not aware that their actions are being observed, they are likely to react in a way which is a truer representation of their approaches than they might when influenced by the presence of the researcher. Although this represents a clear justification for using this method, it should also be noted that, when using observation, there is the possibility that observer bias may well occur. Having three researchers look at the data to draw conclusions helped to minimise individual bias.

Case study 1: Tophat's impact on students' engagement and the provision of feedback

Participants

Students registered on a Year 1 Business Management module were invited to describe their learning experiences with 'Tophat' (an active learning platform) by completing an online survey; thirty-five students participated.

Procedure and student reaction

1.1. Timeline: Prior to Week 1

1.1.1. Content/Action

- Lecturers prepared questions and discussion topics on each module theme and loaded them on Tophat;
- Lecturers checked the classroom arrangement and Wi-Fi coverage;
- An email with detailed Tophat registration instructions was sent to students before the lecture started.

1.1.2. Observation

- Only five students downloaded the software before the class. The other students either did not read the email or did not take any action until they came to the lecture.

1.2. Timeline: Week 1

1.2.1. Content/Action – in the classroom

- The lecturer explained the function of Tophat;
- They then helped students download the software and register their account.

1.2.2. Observation

- Most students were able to download the apps (i.e. through App Store/Google Play), though a few students struggled to manipulate the functions on their phones;
- The quickest student took three minutes to complete the registration process, while the slowest took fifteen minutes.

1.3. Timeline: Week 1-10

1.3.1. Content/Action

- At the start each lecture, an attendance code was generated on Tophat and its use was demonstrated to the class;
- Students were requested to input the code into the Tophat system on their personal digital devices (every code was unique and was deleted after ten minutes);
- Different types of questions – such as multiple-choice, sorting, matching and click-on-target – as well as an online discussion forum were released to students during the lecture via Tophat, serving to encourage students' participation in the lecture;
- A set of questions, designed to test students' understanding of the module content, was released to the students though their digital devices in the last ten minutes of a two-hour lecture;
- The lecturer monitored the results, and the results led to open-ended questions to test knowledge where that appeared to be lacking;
- Lecturers also used the results as a pointer to areas of focus for discussion.

1.3.2. Observation

- Students logged on to the Tophat system and registered their attendance with the code (students not in attendance were not able to get the code);
- The use of some parts of Tophat – e.g. click-on-target, word cloud and matching questions – attracted students' attention and engaged them in the lecture;
- Students were interested in participating in the online discussion forum and rating colleagues' contributions;
- All students actively participated in the completion of the set of questions in the last ten minutes and raised questions when necessary;
- Some students still checked their personal digital devices (e.g. to see if they had any texts) when they were requested not to use Tophat.

Timeline: Week 5

1.3.2. Content/Action

- All the questions which had been discussed in the class on Tophat so far were released, along with the answers for the purpose of student revision.

1.3.3. Observation

- Students did use the revision questions to prepare for their phase test.

1.4. Timeline: Week 11

1.4.1. Content/Action

- Students were invited to participate in a Tophat tournament, the purpose of which was to test their understanding of course content and identify the areas where they required improvement.

1.4.2. Observation

- Students enjoyed competing with their colleagues, though some complained that they could not see the answers for the tournament questions.

Findings

The majority (over 70%) of the students surveyed liked the interactive function of Tophat, through which they could promptly discuss problems with their peers and lecturers. They also perceived that Tophat could support their revision (43%). A few comments in relation to these findings are:

> *'I could discuss problems with my classmates on Tophat through my phone and I could also vote for their comments……'*
>
> *'It gives me an idea how the questions will look like and helps a lot in revision'*

However, some of the students expressed concern about the use of Tophat in the module in their responses to the question 'What is your least favourite part of Tophat?'

> *'It is quite complicated to use….'*
>
> *'I could not do the matching questions on my phone.'*
>
> *'I did not find it's helpful for the exams!'*

Challenges

1. Students' technological ability varies – they are certainly not all digital natives (Prensky, 2001) – and the setting-up time for Tophat in class for is lengthy.
2. Not all Tophat questions (such as matching questions) are supported by the Android system.
3. As this is a management module, short-answer and multiple-choice responses cannot always test the students' understanding properly. It is a challenge to phrase questions that allow students to demonstrate their understanding and enhance their higher-order thinking skills, such as analysis and synthesis and application of knowledge.

Conclusion

This case study demonstrated the complexity of introducing technology into an existing pedagogical approach and in improving students' acceptance and engagement. The benefits of Tophat were recognisable in terms of gaining greater interaction between students and lecturers, monitoring attendance and helping students to prepare for their exam. However, the impact of the human elements, technical facility and subject characteristic factors cannot be ignored when new technology is introduced to the HE context.

Case study 2: SOCRATIVE as a digital literacy technology for the delivery of students' feedback

Introduction

This study investigated the impact of the use of SOCRATIVE (an app that promotes engagement and can be used as an assessment tool) as a digital literacy technology for the delivery of feedback from students.

Participants

Registered students on two courses – a Masters of Information Technology and a Masters of Information Systems – were invited to participate in the investigation of the use of SOCRATIVE as a digital literacy technology for the delivery of students' feedback. Out of twenty-two students who enrolled on the course, eighteen participated in the research.

Procedure and student reaction

1.1. Timeline: Prior to Week 1

1.1.1. Content/Action

- Lecturers prepared questions and discussion topics in relation to each module session's materials, with which students were expected to engage prior to their arrival in the classroom;
- Lecturers checked the classroom arrangement and Wi-Fi coverage;
- The students were notified on the module website of the intention to use SOCRATIVE to test their prior engagement with materials;
- Students were required (they were advised at induction and via follow-up emails) to engage with the required module content before coming to the sessions.

1.1.2. Observation

- Over half of the students engaged with the module content prior to coming to the session;
- This was reflected in their first-week scores, which showed clear understanding of the material.

1.2. Timeline: Week 1

1.2.1. Content /Action - in the classroom:

- Lecturers explained the function of SOCRATIVE and helped students to download the software and register an account;
- Lecturers gave students the SOCRATIVE code for the module;

- Lecturers ensured that all students were able to access the virtual classroom by checking the number logged on to the session.

1.2.2. Observation

- Most students were able to locate the right place to download the apps (i.e. App Store/Google Play), although some went to Google to find and download the software; however, a few students struggled to manipulate their digital devices;
- The quickest student took five minutes to complete the registration process, while the slowest took fifteen minutes and needed assistance from a lecturer;
- All students were able to log on to the virtual SOCRATIVE classroom.

1.3. Timeline: Week 1-10

1.3.1. Content

- At the start of each session, the students in attendance were observed from the software dashboard;
- They were allowed ten minutes to settle in and ask brief questions;
- The SOCRATIVE quiz was then started by means of the 'Start a quiz' button on the dashboard;
- The quiz was made live and student progress monitored as they completed the questions;
- A set of ten questions, designed to test students' understanding of the module content, was released to students through their digital devices in the first ten minutes of the three-hour lecture and tutorial session;
- Students were asked to attempt the ten questions in ten minutes;
- Different types of questions – such as multiple-choice and true/false– were released to students during the lecture via SOCRATIVE, serving to check students' prior engagement with the module content, to check their understanding and to encourage participation in the lecture;
- Lecturers monitored the results and used the results as a pointer for the area of focus for discussion;
- The design of the questions in SOCRATIVE was such that the answers to the questions were released immediately after the response to the questions, providing a formative approach to feedback.

1.3.2. Observation

- All students logged on to the SOCRATIVE system and registered, with the number provided, their attendance in the virtual classroom;
- Students actively participated in the completion of the given set of questions at the start of the session and this afterwards led to some queries from the class.

1.4. Timeline: Week 11

1.4.1. Content

Students were invited to participate in the evaluation of their use of SOCRATIVE and its impact on their studies.

1.5. Observation

The students were generally happy with the use of the software, although they commented that when they had other 'very pressing issues and deadlines' it became difficult to engage effectively with the content ahead of the session.

Rationale for its use

- This approach was necessary because, since the delivery was flipped, there was a need to ensure that the students engaged with the content prior to the classroom sessions;
- Also, since part of the assessment style was a group presentation, it was a way of ensuring that every group member was actively involved in all aspects of her/his group work.

Overall observations

- Students' technological ability varied, though the setting-up time in class had no impact on the teaching and learning time;
- All the SOCRATIVE questions were supported by the different operating systems.

Challenges

- As this was a management module, multiple-choice, true/false and short-answer questions were not able to test the students' understanding properly, but the system did indicate that they had engaged with the materials prior to coming into the classroom;
- It was a challenge to phrase questions that allowed students to demonstrate their understanding and enhance their higher-order thinking skills, such as analysis and synthesis and knowledge application.

Findings

The students liked the use of the SOCRATIVE software and believed that it had a direct and positive impact on their engagement with module materials. Lecturers reported that it also had a positive impact on the quality of their classroom discussions and presentation. A few comments in relation to these findings are:

> *'The course delivery encourages everyone to go and read on their own and formulate their ideas during discussions in class and exhibit course understanding…'*

> *'yes I am very happy because the module is very engaging intellectually, encourages research and personal study thereby bringing out best in you as a student…'*

All of these resulted in a better learning experience, as indicated by some of those who responded to the question 'Are you happy with the delivery of this module?' by stating:

> *'YES, the module is very interactive and makes understanding way easier. Everything about this course just SYNCS perfectly!'*

> *'Yes extremely happy! It's very interactive, motivates us to study wide, hear the opinion of our peers, improve in our presentation skills, time management, team working etc.'*

Conclusion

This study demonstrated the benefits of using digital software such as SOCRATIVE to support a flipped classroom by ensuring that the students engaged with the module content prior to coming into the classroom. However, as stated in the section on the challenges, the key limitation was the fact that more complex questions could not be designed, because SOCRATIVE would not support that level of complexity.

Discussions on the case studies and preamble to the framework

What both case studies have told us is that learning technology has clear impact on students' learning experiences in a variety of ways, most of which might well be said to be of a positive benefit to the learning experience and include greater engagement in the lesson and increased interest in the learning process. Nevertheless, what came through in this research is that there are a number of challenges to be met if these benefits are to occur.

Many of the benefits found reinforced the belief that learning technology helps promote interaction – between students and their peers and between students and their lecturer – and also engagement with the material. This supports much of the literature discussed earlier (Abrami, 2001) that showed how the technology was a means of improving this relationship rather than a catalyst for any great change. Unlike the adoption of a passive approach, the use of learning technology in our case studies means that students are encouraged to engage, through the digital platform, with the subject material provided before classroom sessions (McKnight *et al*., 2016). Research findings also indicated that students spend more time engaging with tasks and discussion with their peers and lecturers inside and outside the classroom. This is consistent with the findings by Kirkwood and Price (2014), who observed that there is a quantitative change – in terms of increased engagement – in the learning experience as a result of using information communication technology in HE.

Digital learning devices also have the capability of testing students' understanding and giving formative feedback – certainly a feature of the first case study. This made it possible to use the software as a platform for revision. In addition, students were observed in both case studies to take ownership of their learning, demonstrating such acquired soft skills as time management, leadership, presentation and team-working etc. in a way that mirrored the conclusion of Venkatesh *et al*. (2014), that integration of ICT may have positive effects on motivation and student interest and also instigate complex cognitive processes.

From lecturers' observations, the students often appeared to be uncertain about why digital learning technology was used in the classroom. In line with the findings of Mueller et al. (2012), they seemed to believe that the digital devices should be used for social rather than academic purposes. However, what was very clear was the correlation between engagement and higher test scores, as students who engaged with the process were far more likely to get a high score in the assessment than those whose engagement was poor. At this stage we can state only that this correlation was there, rather than be certain that it was the engagement digital technology that increased scores; however, there remains strong circumstantial evidence that this was the case.

The findings also indicated a shift from teacher-centred learning to student-centred learning following the adoption of digital learning technology. Some of the these transforming skills could be related to greater use of reflective practice (Cooner, 2010) or collaboration and knowledge-building (Lee, McLoughlin and Chan, 2008) skills, with students having to think about the learning taking place rather than merely accepting the information given. The use of Socrative in case study 2 meant that students had to think actively about things rather than be passive and this was something that certainly contributed well to the lesson.Furthermore, lecturers were able to identify quickly areas in which students struggled, track students' progress and provide feedback in a novel way; as a result, the students felt greater satisfaction about their learning experience.

Although this research has found many positives regarding the use of digital technology in class, lecturers also had negative experiences, including: increased time needed at the start of the session to ensure all learners were logged on; pressure on lecturers to improve their ability with technology; students' in-class disruption (specifically, students using their digital devices for non-academic purposes); the inability of lecturers to prevent or manage, in a timely manner, the unethical behaviour of some students. Such behaviour may consist of impolite comments on the work of their peers and posting insensitive remarks. Many of these points have helped to highlight the fact that to characterise students as digital natives (Prensky, 2012) is far too over-simplified; the travails of some students in dealing with the technology was symptomatic of the fact that the student body is a highly disparate group which should not be thus stereotyped,

A framework: Identifying best practice in using learning technology in higher education?

The original purpose of this research was to create a framework that can be used when introducing learning technology into the classroom. This framework is designed to be applicable to multiple types of technology and, from reflection on both the literature and the two case studies, it is clear that there are some steps that can help lecturers when using digital technology. The framework is presented in table 1.

It comprises three stages: pre-class preparation, in class and after class . These stages are made up of different steps which are identified and listed in table 1. For the first stage, eleven identified steps and six resources are required. For the second stage, seven steps and resources are identified, while the third stage comprises three steps and six resources.

Table 1: Learning Technology Conceptual Implementation Framework

Stages	Steps	Resources
Pre-class preparation	1. Form the teaching team 2. Equip the team with the necessary technology skills and devices 3. Meet and discuss the process, roles and responsibility 4. Determine which technology fits with the teaching objectives 5. Agree on how to embed the learning technology in the curriculum; avoid having it as a standalone activity. 6. Design the questions (self-study, in-class discussion, understanding test, homework) which could facilitate the achievement of the teaching objectives 7. Investigate the suitability of the institution's learning technology infrastructure 8. Pilot in the classroom where the lecture/seminar will take place 9. Set up the virtual classroom 10. Send the students invitations to the virtual classroom 11. Provide the student guidance notes for setting up the account on digital devices	• Teaching team • Digital devices • Internet • Software licence • Classroom • Subject material • Checks on compatibility of software
In class	1. Carry out an initial diagnostic of the students' technical skills and ability 2. Check the suitability of students' mobile devices 3. Introduce the function of the learning technology tools and its purpose 4. Release the questions to the digital devices 5. Observe students' engagement and participation with the devices 6. Encourage student involvement in the process 7. Demonstrate the benefits of the learning technology and its linkage with the teaching objectives.	Additional to the resources in the preparation stage: • Students' digital devices
After class	1. Reflect on the outcome of the usage 2. Ascertain students' feedback on the learning technology 3. Improve the teaching for the next session on the basis of students' feedback and reflection	The resources in the preparation stage

Conclusion

Although the benefits of embedding digital learning technologies in HE have been explored widely, detailed guidance or frameworks on how to use them have not been clearly introduced. This research has focused on interactive learning technology tools and seeks to ensure that all lecturers have a framework within which to work. What has been clear throughout the research is that using this framework (or indeed using digital technology in general) will not make a bad lesson good nor, indeed, stop all poor behaviour; what it can do is to encourage students to engage more with material and change them from passive recipients to active participants. A further caveat is that, lecturers must not fall into the trap of assuming that students are all digital natives (Prensky, 2012) and that their skills are such that they are able to interact with technology and use it to their advantage. While this may be true for some students, it may not be true of all. Linked to this common misconception is the belief that digital technology, when allied to other techniques such as flipped learning, will automatically change passive students into active participants. Our research suggests this is not the case. To reiterate the point, the use of the framework is likely to be beneficial to the lesson but should not be regarded as a panacea for all ills.

The key to the success of a lesson utilising learning technologies is ensuring that they add to the lesson and are used to achieve the objectives rather than as an end in their own right. By implementing the framework, lecturers will ensure that the use of learning technology runs smoothly and has the maximum possible chance of helping the students to engage with the lesson and also of promoting a positive learning environment.

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