STUDENT USE OF INTERACTIVE TECHNOLOGY IN LARGE FACE-TO-FACE LECTURES POST-PANDEMIC – ISSUES AND OPPORTUNITIES

C. Holtham, M. Rich, L. Huang

City, University of London, Bayes Business School (UNITED KINGDOM)

Abstract

The conventional lecture, based on transmissive pedagogy, in a large physical classroom has been under challenge for decades. Lockdown meant the abandonment of physicality, and established a greatly expanded level of viability for virtual and less didactic learning. But the circumstances and practicalities of emergency remote teaching were far from ideal for establishing the positive aspects of virtual learning technologies.

Top-down pressures from governments and university senior managers have actively promoted return to the physical classroom, perhaps with a hybrid component as a second-best fallback option in parallel. One possible scenario is that there will be a slow but steady return to pre-2020 pedagogic methods, and lessons from lockdown become slowly forgotten.

This paper focusses on alternative architectures for the post-pandemic physical classroom experience, specifically in relation to large lectures (50 and upwards). It does not address the hybrid classroom, only wholly physical gatherings. Its starting points are:

- pre-pandemic use of technology by students in large lectures, in particular polling (broadly defined), historically via clickers, but now via phones or other keyboard devices.
- "electronic-meeting systems" where all participants in a face-to-face business meeting are intimately connected via specialist collaborative software
- cumulative experiences from synchronous online classes, both during and before the pandemic, where a wide range of tools were deployed that could remain relevant in a physical classroom. Video-conferencing apps, universally deployed during lockdown, play much less part in a physical classroom context.

Although there are a large range of pedagogies which are applied to large lectures, we deliberately simplify this to two of the most numerically important:

a) transmissive learning, dealing with well-established bodies of knowledge

b) active learning, where there are higher levels and a variety of types of student engagement

Our conclusions are:

(1) Higher education should address the issue of in-classroom use of technology by students holistically, not as a series of discrete online applications for voting, digital sticky notes etc. Issues such as the interactions with the VLE, and in particular with generic office applications, collaboration and storage technologies need to be carefully considered

(2) Far more attention needs to be given to the ease of learning, set up and live use by faculty, both before and during the lecture. For example, technologies which are excellent for students may place excessive burdens on the "averagely" technology skilled faculty member.

(3) Generic office automation and collaboration software already have features which are scarcely used in higher education generally, let alone in classrooms. Given the continual innovation in this type of software, this may facilitate new opportunities for in-classroom use.

(4) Lecture room technology for students needs urgent research and development at national and institutional levels, not only into special needs of higher education which are unlikely to be met commercially, but also into small-scale bottom-up (and "low/no cost") innovations, and in disseminating the work of existing innovators.

Keywords: Post-Pandemic, Lectures, Synchronous, High-Engagement, Classroom.

1 INTRODUCTION

1.1 Initial concerns stimulating a review

Work on this paper was initiated in the particular conditions of a primarily face-to-face learning environment for undergraduate students in Autumn 2022. In the UK there were considerable pressures from government, university senior management and the Office for Students to return to fully face-to-face teaching. Lockdown had meant the abandonment of physicality, and established a greatly expanded level of viability for virtual and less didactic learning. But this also meant that in practice the cohort of new students in 2022 had had relatively little experience of face-to-face teaching, and (as had also been the case pre-pandemic) negligible experience of being in large lectures. Dr Martin Rich, the Associate Dean responsible for undergraduates, articulated his concerns to colleagues in the Faculty of Management. His focus was on learning in the physical classroom, particularly for large lectures. Dr. Rich's detailed call to action ("Opportunities from our current challenges") [1] is provided here in full:

"We have now moved on from our spell of Emergency Remote Teaching and this period has been characterised by contrasts. In most respects we are back to in-person teaching as our principal mode of instruction: we are running invigilated exams and have put considerable targeted effort into supporting students through these, we are encouraging attendance and activities to create a buzz around the building, and my personal experience has been that the quality of interaction with students in person over the last year has been very high indeed. At the same time we have a proportion of students who for health reasons or because of travel restrictions continue to study online. We need to support these online students and my expectation is that this requirement for a minority of students will continue indefinitely. An important distinguishing factor of our teaching is that all students, even within a very large cohort, have a significant amount of small-group teaching typically along with twenty or fewer other students. But this exists in tandem with large formal lectures which remain important, but as one of a range of approaches to teaching. Another distinguishing factor for us is that students are actively encouraged to go beyond the curriculum and to use it as a basis to explore areas of interest.

One of our biggest challenges is to provide an element of personalisation within this large cohort, and it has been exacerbated by our success in recruiting large numbers of students in recent years and by the difficulties in scaling our systems to deal with these numbers. Small-group teaching is relatively straightforward, though resource-intensive, to scale because it is possible to add additional groups. Larger group teaching demands approaches to deliver material which is right for particular students. Our students are very familiar with using a VLE in simple form as a repository for information, a portal for resources elsewhere on the Internet, and a platform for assessment. However, it has proved difficult to deliver online material which can be adapted for particular students, either because they need additional support in a particular area or because they want to pursue particular additional interests.

So our need is for tools which can facilitate personal learning with larger groups of students. If these can connect with analytics, both by generating analytic data and by using analytics to identify needs for particular students, that is all the better. As mentioned above the large lecture setting is valuable as one of a range of different ways to learn. It is most valuable if we can ensure that we use students' time in large lectures effectively for the sort of material that large lectures are good at.".

2 METHODOLOGY

2.1 Overall perspective of review

Professor Clive Holtham, Director of the Bayes Business School Learning Laboratory, responded to the Associate Dean's challenge through a two-month review, with it overall aim being: "to enrich undergraduate engagement in the physical classroom through design and use of a structured palette of technology tools.". Firstly, there was consideration of active learning pedagogy. Secondly, there was a focus on examining software designed to promote active learning, particularly in large lectures.

2.2 Review from Pedagogic perspective

The learning design review focussed on alternative settings for the post-pandemic student experience, condensed down to three broad settings – Physical classroom, fully online spaces, and physical classroom supplemented by synchronous remote access (Hybrid), but focussed only on the first, and in particular on "large" lectures (50 and upwards). We analysed three particular functions for large

lectures, with the most typical and most common being its roles in knowledge transfer. There is also importance in taking advantage of the physical co-presence to support building of a learning community, particularly through small-group collaboration, and oral interactions within the room more generally. A third role, less pedagogically significant, is as a briefing, most commonly at the beginning of the year or term, or as a special event, perhaps with a guest speaker.

Table 1: Broad functions of a large lecture

Type	**Purpose**
Knowledge Transfer	Learn/develop skills
Community	Collaborate/decide
Event/Briefing	Promote/inform

Although there are a large range of pedagogies which potentially are applied to lectures, the review deliberately simplified this to two of the most numerically important:

- transmissive learning, typically dealing with well-established bodies of knowledge
- active learning, where there are higher levels of, and a variety of types of, student engagement

Freeman carried out a meta-analysis of 225 studies in STEM higher education, comparing active learning and traditional lecturing, and produced a widely used definition of active learning [2]:

“Active learning engages students in the process of learning through activities and/or discussion in class, as opposed to passively listening to an expert. It emphasizes higher-order thinking and often involves group work”.

Bonwell [3] wrote an early influential report on active learning in higher education, which remains a useful summary. A review in engineering by Prince [4] concluded:

“...students will remember more content if brief activities are introduced to the lecture. Contrast this to the prevalent content tyranny that encourages faculty to push through as much material as possible in a given session.”

In relation to the current theory of active learning, in Table 2 we summarise on more recent European work by Redecker and Punie, p22 [5], whose DigCompEdu framework usefully widens the focus to cover inclusivity and personalisation.

Table 2: DigCompEdu Empowering Learners (Abridged)

Accessibility and inclusion
To ensure accessibility to learning resources and activities, for all learners, including those with special needs.
To consider and respond to learners’…expectations, abilities, uses and misconceptions…
Differentiation and personalisation
… to address learners’ diverse learning needs, by allowing learners to advance at different levels and speeds, and to follow individual learning pathways and objectives.
Actively engaging learners
…to foster learners’ active and creative engagement with a subject matter… within pedagogic strategies that foster learners’ transversal skills, deep thinking and creative expression.
To open up learning to new, real-world contexts, which … increase learners’ active involvement in complex subject matters.

Although reviews of active versus transmissive learning may present these as two polar opposites, in a modern university there is likely to be a spectrum, with individual faculty themselves being willing to move along the spectrum between active and transmissive, even within a single one or two hour “lecture”. Experienced faculty may have evolved their own “toolbox” or “palette” of pedagogic methods

without even necessarily being aware of the term “active learning”. In the specific context of the Bayes review, the priority was not to replace transmissive with active learning, but rather to encourage faculty to widen their palette of pedagogic methods to include a greater proportion of active learning methods where appropriate, and also to promote inclusivity and personalization as in the DigCompEdu framework.

2.3 Review from technology-based learning perspective

In relation to technologies to augment the face-to-face classroom experience, the business school had a long history of innovation:

- 1991 Videoconference training for MBA’s
- 1995 Boardroom of the Future (electronic meeting system using portable LAN). This allowed participants in a face-to-face business meeting being continuously connected via specialist collaborative software allowing brainstorming, voting and prioritising.
- 2002 Founding of Business School Learning Laboratory
- 2005 Macromedia Breeze for synchronous conferencing (evolved into Adobe Connect)
- 2005 Clicker polling pilot (favoured over phone-based system), eventually with over 200 clickers being used in large lectures by the late 2010’s.

Lockdown and the emergence of emergency remote teaching led to new cumulative experiences from synchronous online classes. A wide range of tools were deployed that could remain relevant in a physical classroom. Video-conferencing apps, universally deployed during lockdown, however, play much less, if any, part in a physical classroom context. Reviewing the contemporary technologies potentially available in a lecture room to individual learners using a phone, tablet or laptop would include at least the following categories:

- Polling/voting
- Formative assessment
- Sticky notes
- Competitions
- Whiteboards
- Office personal software (notetaking, web access)
- Office collaboration software (document sharing, presentation sharing, PDF readers)
- Functions within video-conferencing (screen sharing, chat, breakouts)
- Specialist collaboration platforms (pre-pandemic)
- Electronic meeting systems

During lockdown, emergency remote teaching was often heavily driven by the priority given to a combination of video-conferencing with sharing of presentation software, particularly MS Teams and Zoom, in both cases with Powerpoint as the dominant presentation software. However, long before lockdown, there had evolution of what might be called “meeting-oriented engagement platforms” such as Webex, Blackboard Collaborate and Adobe Connect, that included video but perhaps not as comprehensively as Teams or Zoom. These were often widely used in business education and training, perhaps called web conferencing or virtual classrooms..

Before lockdown there had also been the evolution of “teaching-oriented engagement platforms” such as Nearpod, PearDeck, and Wooclap. These may not have had the video conferencing features popularised during lockdown, but with the return to the physical classroom they have come under closer consideration in higher education. Nearpod and PearDeck have been geared to school environments, but for those with a focus on active learning they have distinct features, above all that they offer relatively powerful features with a more modest learning curve than often found in business software. However, both the meeting and teaching engagement platforms now face teachers who are now often fluent in video-conferencing based solutions, in ad hoc tools such as polling and sticky note software, and perhaps above all in Powerpoint as presentation software.

The active engagement features of Nearpod, PearDeck and Wooclap can import Powerpoint content. Though they do not have anything like the full functionality of Powerpoint for specialist presentations,

they do provide an integrated platform for designing and creating high-engagement learning, including an emphasis on ease of use. Powerpoint plus varying add-ins can be deployed to similar effect but not with the ease of design and ease of use of the teaching engagement platforms.

As the technology review was nearing conclusion, it transpired that in 2019 shortly before lockdown there had been a small study in the university that had identified Nearpod as a suitable candidate for an active learning trial, but at that time there was little interest expressed across schools. Shortly after all resources were, in any case, concentrated on emergency remote teaching. A key issue in the small study was the active learning functionality in teaching-oriented engagement platforms. Another key issues in the small study had been the successful use of Nearpod by major UK universities such as Manchester [6], [7], Ulster [8], [9] and Portsmouth [10], as well as internationally [11], [12], [13], [14], [15], [16], [17].This has been a key factor in the business school technology review. The existence and success of peers who have gone through the early adopter phase, significantly reduces the risk for later adopters. The outcome of the technology review was to recommend that Nearpod be piloted on a trial basis in 2023, to evaluate if it could accelerate the active learning and personalisation sought by the Associate Dean.

In its own terminology Nearpod [18] offers four types of feature:

- Content creation
- Interactions
- Quizzes and games
- Discussions

An illustration of a Nearpod designed session is provided in Figure 1 below. Although superficially this appears similar to a Powerpoint slide sorter, what distinguishes Nearpod is that it is heavily geared not to content delivery, but rather to encourage the teacher or learning designer to weave in and deliver active learning components in a highly integrated way, not as plug-ins or add-ons.

3 RESULTS

3.1 Internal expertise was unexpectedly already present

One result of the business school review was that internal discussions identified that the school already had recently recruited as a Bayes Fellow an experienced and creative user of Nearpod, Dr Linlan Huang, who quickly became a member of the active learning project team, and who below outlines his experiences.

3.2 Nearpod as a platform: based on experiences of Dr Linlan Huang

I have been using Nearpod for two years as a lecturer of business studies in higher education settings. The modules I teach include Marketing, Organizational Behaviour, Business Management and Economics. I used Nearpod for synchronous and face-to-face teaching with both small (less than 30 students) and large cohorts (more than 60 students). I frequently used games, discussion and interactive functions, which fit in my teaching philosophy based on constructivism and improve the student-centred learning experience. The mission of my class is to enable students to construct their understanding of core subject knowledge in business and also develop practical skills that can be used in their future careers as business leaders. In my experience, using Nearpod for face-to-face and synchronous classes is more effective because students' engagement in the interactive activity is usually higher. Students can comment on each other's work, learn from each other's life stories and benefit from my real-time feedback.

The stylized screenshot in Figure 1 shows an example of my international business environment class design using Nearpod. In designing the course, I often start with an agenda and introduction to important themes, then give students opportunities to explore the important business concepts through drag-and-drop exercises, fill-in-blanks, matching pairs and memory tests. After giving feedback on their response, I often use videos, podcasts and slide shows to introduce the concept from theoretical and practical perspectives comprehensively. Flip, open questions and quizzes follow-up tests to check their understanding and learning progress. At the end of each class, I usually run a quick poll to understand students' learning experiences so I can improve my class design and delivery.

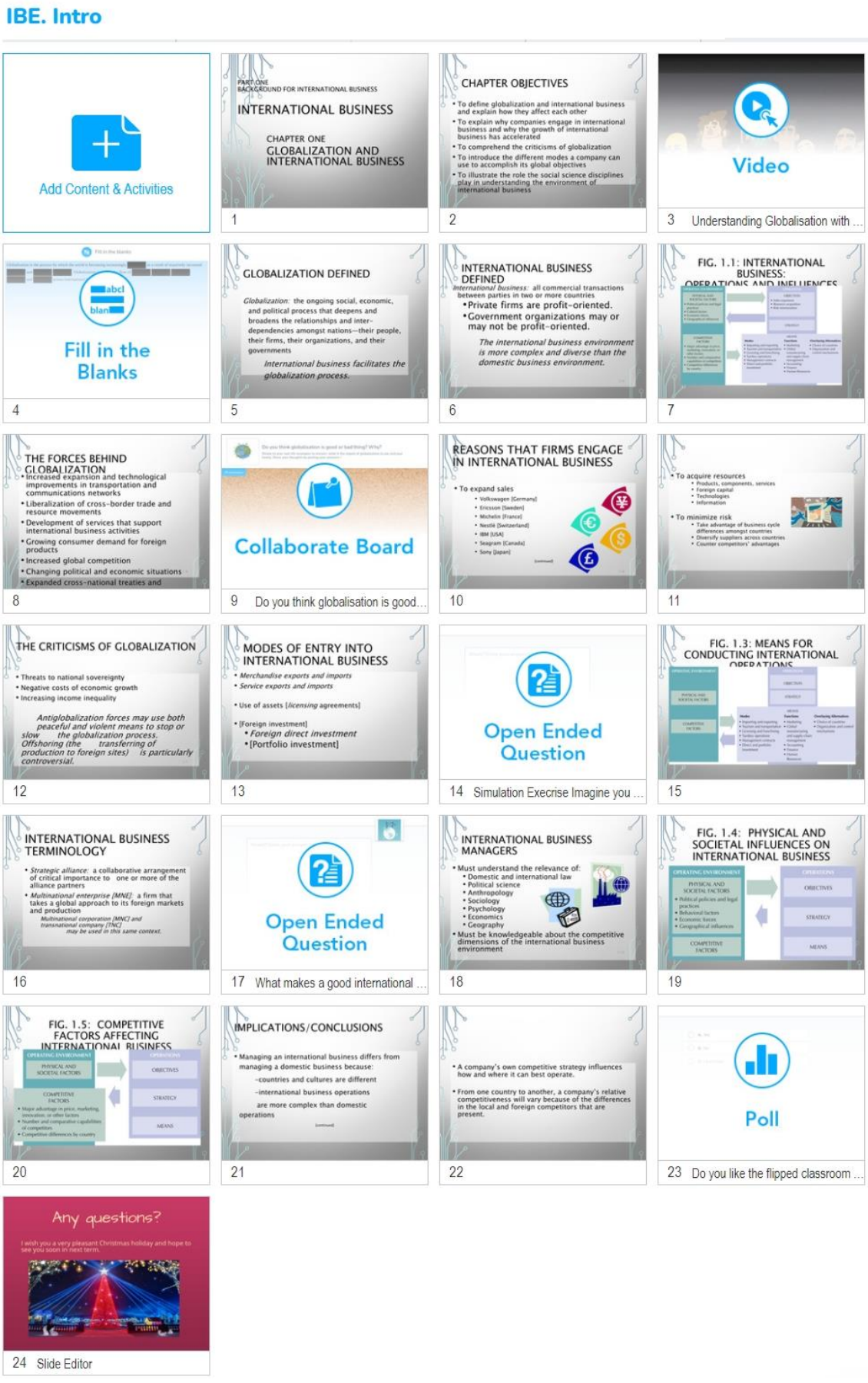

Figure 1: Overview of Nearpod Business Class: Six Interactive Components highlighted in blue.

There are many advantages of using Nearpod for large-scale classes. First, it is a systematic platform for lecture design which enables teachers to gather all elements and resources in one place. Although there are single add-on features provided by alternative applications such as Kahoot Quiz, Google Forms, PollEverywhere, Padlet, etc., they are quite fragmented in functions. They can cause confusion for students when lecturers switch from one activity to another if additional instructions are not given. Second, Nearpod provides an 'easy start' for both students and teachers. Students can access my teaching content without a complicated pre-registration process, while teachers can easily organise and design the course content. No programming knowledge is needed for either side. Third, the sharing function of Nearpod allows collaborative course design between other teachers and me, so everyone keeps on the same page. This is particularly useful when other colleagues need to cover my teaching sessions or the course is co-delivered by more than one teaching staff. In addition, Nearpod is integrated with many new features such as 3D, VR, simulation, flip and so forth. These features are useful for practical skill training, such as job interviews, market research of different regions, and case study about the business environment.

The disadvantages of Nearpod are two-fold, based on my observation. First, some essential functions still need to be included, including an interactive map, word cloud and data visualisation tools. These functions are helpful for inspiring students' creativity in data analysis, in which students can input textual data, and the system will show it in a visualised way. It is now provided by polling applications, including PollEverywhere, but it seems an overlook in Nearpod. Second, Nearpod was originally designed for K-12 education, and many learning resources provided by 'Nearpod Library' are less relevant to higher education settings. There should be more supportive resources developed by and shared for communities of lecturers in higher education, depending on the needs of different disciplines.

3.3 Dr Huang’s overall assessment of Nearpod

The use of Nearpod deserves further exploration and reflection in the context of higher education institutions. Having technology is a good thing; however, it needs to match with suitable pedagogies in order to maximise its functionality and potential. For example, the use of Nearpod may go well with flipped learning and active learning but may show its limitations for another pedagogical approach. The use of Nearpod also needs to match with course design in the constructive alignment style. Meanwhile, the use of Nearpod is subject to the constraints of institutional environment and context, for example, timetabling, the configuration of lecture/tutorials, student's background, personal relationships among teacher/students, and learning culture/atmosphere in the student cohort. Educators in different institutions should consider each of those factors in their own context to put forward the most effective method of Nearpod-supported teaching. Lastly, it is always helpful to have a plan B when Nearpod does not function well due to an unstable internet connection for a large cohort or other technical difficulties.

4 CONCLUSIONS

This has been a scoping study of one approach taken to the post-pandemic context for higher education learning and technology. Much of the theorising on post-pandemic teaching and learning tends to focus on situations likely to be universal or frequently occurring across many institutions. In reality, it can be expected that there will be many diverse responses, hinging perhaps on the approach favoured in crime fiction of means, movie and opportunity.[19].

In this scoping study, the motives were very clearly articulated by the Associate Dean in October 2022. In relation to means, a formal review of pedagogic and technologic alternatives led to a preferred technology for exploratory and pilot work in 2023. Discussions on this uncovered two opportunities unknown in October. One was the institutional study in 2019 which had come up with the same preferred technology. The second was realising there was an existing member of staff who had in-depth expertise in that technology.

The favourable conjunction of motive, means and opportunity has led to the planning of a series of carefully designed demonstration projects during the first half of 2023, aimed at demonstrating the potential of a teaching-oriented engagement platform.

During the pandemic, a strong influence on technology choices was the use of "best of breed" thinking about individual tools, whether video conferencing, or sticky notes or whiteboarding apps. Post-pandemic, not least due to constraints on support resources, there is a need to be more discriminating about where best of breed is appropriate, and when it is not. Students may also be less tolerant of multiple apps for specific functions with a return to learning again dominated by physical lectures and classes.

What has become apparent from this scoping study is that more attention may need to be devoted to technology applications which simplify creation, deployment and use by busy faculty, rather than those that are "powerful" but involve steeper learning curves and may be difficult to work in harness. We propose that Higher education should address the issue of in-classroom use of technology by students holistically, not as a series of discrete online applications for voting, digital sticky notes etc. Issues such as the interactions with the VLE, and in particular with generic office applications, collaboration and storage technologies need to be carefully considered

Valuing simplification over complexity is a classic case of “disruptive” technology, not least as developed by Apple. Disruptive technology may be un-attractive to mature expert users, but attract a new type of user who value ease of use over functionality and complexity [20].

Presentation software was popularised by the invention of both Harvard Graphics [21] and Lotus Symphony in 1986. Foresight Powerpoint came out in 1987 and Foresight was bought that year by Microsoft. Such software has incredible breadth and depth, but many users simply use a narrow sub-set of the functionality, essentially to make presentations. It can be augmented through add-ons for polling, and it interacts with other Microsoft applications. It is almost optimised for transmissive teaching but flexible enough that other pedagogies can also be supported, at least up to a point.

We have coined the term earlier of "teaching-oriented engagement platforms”. Such platforms need to include presentation capabilities but should not be constrained by such capabilities. Figure 1 shows very visibly how a platform does not privilege presentation functionality, but makes it straightforward to design and immediately integrate active learning functionality alongside the transmissive.

Far more attention needs to be given to the ease of learning, set up and live use by faculty, both before and during the lecture. A teaching-oriented engagement platform which is easy to learn and use by faculty generally, is not likely to suit power users of presentation technology. And even technologies which are excellent for students, may place excessive burdens on the “averagely” technology skilled faculty member.

Although not within the remit of this project, we would also note that generic office automation and collaboration software already have features which are scarcely used in higher education generally, let alone in classrooms. Given the continual innovation in this type of software, this may facilitate new opportunities for in-classroom use.

Finally, lecture room technology for students needs urgent research and development at national and institutional levels, not only into special needs of higher education which are unlikely to be met commercially, but also into small-scale bottom-up (and “low/no cost”) innovations, and in disseminating the work of existing innovators.

ACKNOWLEDGEMENTS

Software has been made available to Bayes Business School by Nearpod USA gratis for a trial period, also use has also made of the no-cost Nearpod Silver version.

REFERENCES

[1] Martin Rich, “Opportunities from our current challenges,” Oct. 03, 2022.

[2] S. Freeman *et al.*, “Active learning increases student performance in science, engineering, and mathematics,” *Proceedings of the National Academy of Sciences*, vol. 111, no. 23, pp. 8410–8415, Jun. 2014, doi: 10.1073/pnas.1319030111.

[3] C. C. Bonwell and J. A. Eison, “Active Learning: Creating Excitement in the Classroom,” ERIC Clearinghouse on Higher Education, Washngton DC, 1991. Accessed: Jan. 12, 2023. [Online]. Available: https://eric.ed.gov/?id=ED336049

[4] M. Prince, “Does Active Learning Work? A Review of the Research,” *Journal of Engineering Education*, vol. 93, no. 3, pp. 223–231, 2004, doi: 10.1002/j.2168-9830.2004.tb00809.x.

[5] C. Redecker and Y. Punie, *European framework for the digital competence of educators: DigCompEdu*. LU: Publications Office of the European Union, 2017. Accessed: Dec. 09, 2022. [Online]. Available: https://data.europa.eu/doi/10.2760/159770

[6] S. J. Wood, A. Woywodt, M. Pugh, I. Sampson, and P. Madhavi, “Twelve tips to revitalise problem-based learning,” *Medical Teacher*, vol. 37, no. 8, pp. 723–729, Aug. 2015, doi: 10.3109/0142159X.2014.975192.

[7] J. Tyldesley and N. Nielsen, *From Mummies to Microchips: A Case-Study in Effective Online Teaching Developed at the University of Manchester*. Routledge, 2020.

[8] S. McClean and W. Crowe, “Making room for interactivity: using the cloud-based audience response system Nearpod to enhance engagement in lectures,” *FEMS Microbiology Letters*, vol. 364, no. 6, pp. 1–7, Mar. 2017, doi: 10.1093/femsle/fnx052.

[9] D. Lyttle, “Engaging students in the classroom and online: 29th International Networking for Healthcare Education Conference 4-6th September 2018,” Sep. 2018, p. 1.

[10] A. Siani, “BYOD strategies in higher education: current knowledge, students’ perspectives, and challenges.,” *New Directions in the Teaching of Natural Sciences*, no. 12, Art. no. 12, Sep. 2017, doi: 10.29311/ndtps.v0i12.824.

[11] J. Wang and I. Chia, “Engaging Students via Nearpod® in Synchronous Online Teaching,” *Management Teaching Review*, vol. 7, no. 3, pp. 245–253, Sep. 2020, doi: 10.1177/2379298120974959.

[12] M. Sanmugam, A. Selvarajoo, B. Ramayah, and K. Lee, “Use of Nearpod as interactive learning method,” in *INTED2019 Proceedings*, 2019, pp. 8908–8915.

[13] M. Hakami, “Using Nearpod as a tool to promote active learning in higher education in a BYOD learning environment.,” *Journal of Education and Learning*, vol. 9, no. 1, pp. 119–126, 2020.

[14] R. Burton, “A review of Nearpod – an interactive tool for student engagement,” *Journal of Applied Learning and Teaching*, vol. 2, no. 2, Art. no. 2, Dec. 2019, doi: 10.37074/jalt.2019.2.2.13.

[15] T. W. Jing and W. S. Yue, “Real-Time Assessment with Nearpod in the BYOD Classroom,” in *Assessment for Learning Within and Beyond the Classroom*, Springer, 2016, pp. 103–107.

[16] A. Al Redhaei, M. Awad, and K. Salameh, “Assessing the Impact of Gamification in Higher Education: An Experimental Study using Kahoot! and Nearpod During COVID-19 Pandemic,” in *2022 Advances in Science and Engineering Technology International Conferences (ASET)*, Feb. 2022, pp. 1–6. doi: 10.1109/ASET53988.2022.9734892.

[17] N. Shehata, C. Mitry, M. Shawki, and M. El-Helaly, “Incorporating Nearpod in undergraduate financial accounting classes in Egypt,” *Accounting Education*, vol. 29, no. 2, pp. 137–152, Mar. 2020, doi: 10.1080/09639284.2019.1704806.

[18] *Using Nearpod in the University*, (Jun. 01, 2022). Accessed: Dec. 08, 2022. [Online Video]. Available: https://www.youtube.com/watch?v=SL0D7Cwlgis

[19] S. Goodin, C. Weber, P. Pearson, and T. Raphael, “Comprehension: The means, motive, and opportunity for meeting the needs of diverse learners,” *Handbook of research on literacy and diversity*, vol. 1, pp. 337–365, 2009.

[20] C. M. Christensen, *The Innovator’s Dilemma: When New Technologies Cause Great Firms to Fail*. Harvard Business Review Press, 2013.

[21] Sharon L. Rufener, “Harvard Graphics Is Easy to Learn and Use,” *InfoWorld*, pp. 47–48, May 1986.