INNOVATIVE USE OF LECTURE CAPTURE TECHNOLOGY IN UNDERGRADUATE YACHT DESIGN AND POSTGRADUATE SHIP DESIGN COURSES

J-B R G Souppez, Solent University, UK.

SUMMARY

Over the past decade, higher education has witnessed an increasing student demand to integrate modern technologies as part of the teaching, an example of which is lecture capture. Furthermore, there is supporting evidence that engagement with lecture capture has a positive impact on student achievements, including greater commitment to the course and better performance in summative assessments and examinations. Building on the latest features of lecture capture technology and following a successful pilot study, micro-lectures with embedded quizzes have been implemented at both undergraduate level on the BEng (Hons) Yacht and Powercraft Design, and postgraduate level on the Integrated Advanced Ship Design Master course (EMship+). Using an action-research methodology together with qualitative and quantitative student data, the development of this innovative use of lecture capture technology will be presented.

1. INTRODUCTION

Among the challenges faced by contemporary higher education is the outreach and widening of the access to university, aiming to attract students from a range of educational and socio-economical backgrounds, as well as first-generation university students. As a consequence, institutions need to offer means to support those students, and the recent improvements in learning and teaching technologies have provided an opportunity to do so. In the United Kingdom, this is also driven by governmental metrics intended to reflect the quality of teaching, such as the Teaching Excellence Framework (TEF), or the National Student Survey (NSS).

In order to ascertain the opportunities offered by the latest lecture capture feature, namely embedded quizzes, to support students, the action research methodology has been adopted. An intervention has been planned and implemented, and a reflection on self-practice has been sparked by the observations made, leading to further refinement of the proposed solution. The innovative approach to lecture-capture technology presented here was then trialled on two units, first on a short course at level 7 on the European Masters Course in Integrated Advanced Ship Design (EMship+), then over an entire academic year on a level 4 unit of the BEng (Hons) Yacht and Powercraft Design at Solent University.

The motivations behind the intervention will be outlined, providing background to both the action research methodology and e-learning theories. The analysis of the viewing patterns and quizzes results at the pilot study stage allowed to further develop the micro-lectures and embedded quizzes. Two case studies will then be presented, looking at the results on the EMship+ course and the BEng (Hons) Yacht and Powercraft Design, particularly focussed on the viewing patterns of the micro-lectures with embedded quizzes compared to the traditional full lecture captures. Eventually, the viability of the new innovative use of lecture capture in a short format with embedded quizzes will be discussed, showcasing its larger impact compared to the traditional use of lecture capture technology in higher education.

2. BACKGROUND

2.1 MOTIVATIONS

Student engagement has been an emerging topic in the higher education literature [1], with particular emphasis on student success. Indeed, student engagement has been shown as a primary remedy to failure across modern British universities, and an opportunity to improve the learning environment [2]. This cannot only be promoted by improved teaching practices, and also requires the merging with Virtual Learning Environments (VLE) and novel technologies, such as lecture capture [3].

2.2 ACTION RESEARCH METHODOLOGY

The action research methodology is generally attributed to Kurt Lewis, who developed the *field theory* concept in the 1930s [4]. However, the rejection of the positive paradigm across America in the 1940s and 1950s lead to a much different view of the action research being developed in the United Kingdom, with an extensive development from the 1970s [5]. The aim of the British action research was to construct learning and teaching through processes, aiming to enable teachers to refine their practice through systematic reflection. This is further strengthened by Biggs' [6] statement: *"systematic reflective practice is what action research is about"*. Biggs also characterises the process of action research as defining a problem that is focussed on what the students do, implementing a solution, monitoring the changes and then fine-tuning the proposed solution.

Another core element of action research advocated by Biggs [6] is the role of the critical friend, that has the ability to identify aspects of teaching that oneself could not see. Indeed, action research is also about reshaping the teaching experience, and to a greater extent achieving a higher understanding of one's self [7]. Winter [8] had also previously noted that, in order to foster the learner/teacher dialogue, a transformation of one's self is necessary, and could be best implemented through reflective practice.

Furthermore, building on the *'reflective practitioner'* concept promoted by Schön [9], Leitch and Day [10] revealed that action research represents an important aspect of the teacher's development, and that so far the reflection and its relationship with the curriculum have been neglected. Hence the motivation to also look at incorporating the proposed intervention as part of the curriculum.

Finally, ethical issues have a central place in action research; the intervention planned was therefore performed to the whole course, without any control groups. This ensures all students are given an equal opportunity to succeed, thus in line with Solent University's quality and ethical policy, as well as current best practice in action research [11].

Due to the nature of the proposed action research, revolving around technology enhanced learning, and more precisely the lecture capture technology, this aspect should also be tackled.

2.3 E-LEARNING AND LECTURE CAPTURE

There is an ever increasing demand from students for enhanced virtual learning experiences [12], whether it is via Virtual Learning Environments (VLE), Sharable Content Object Reference Models (SCROM), Massive Open Online Courses (MOOC), or Lecture Capture (LC). It is therefore no surprise to see lecture capture as one of the most significant technologies involved in the transformation of higher education [13], with a very positive student perception, particularly regarding their success in higher education [14].

Furthermore, the implementation of lecture capture at Solent University has already revealed an increase in grades of up to 20% for lower achieving students [15]. This reinforces the rationale behind this action research aiming at supporting students through micro-lecture captures and embedded quizzes. In addition, a study conducted by Traphagan *et al*. [16] put into evidence that access to vodcast was linked to higher achievements. There is therefore a strong case for the use of lecture capture technology to support students, the majority of them perceiving lecture capture as a mean to improve their grades [17].

One of the criticism made towards MOOCs by Woll *et al*. [18] is a lack of engagement with the videos, with the learner being in a passive position. The recommendation made is therefore to include a gamification aspect, with regular quizzes to keep the learner alert and engaged. Nevertheless, a compromise is to be found: the questions must be challenging enough to raise interest, but not too difficult, which could induce stress and disengagement. Action research therefore appears as the most suited methodology to implement an intervention aimed at promoting student engagement with micro-lecture captures and embedded quizzes.

3. INITIAL PILOT STUDY

3.1 THE INTERVENTION

Action research is, by nature, an iterative process, based on repeated cycles of planning, action, observation and critical reflection, as suggested by Zuber-Skerritt [19], and supported by Winter [20].

The cyclic process however needs to be refined, iterating towards a final solution, as change is needed in order to achieve progress. This has been acknowledged since antiquity, with the Greek philosopher Heraclitus stating: *"we never step in the same river twice"*, and Einstein being attributed the definition of madness as: *"doing the same thing over and over again, and expecting different results"*.

Two action research cycles have been completed in this instance, the first one being the pilot, the second one looking at the integration of the micro-lecture captures into the curriculum. The action research methodology employed is presented in Figure 1.

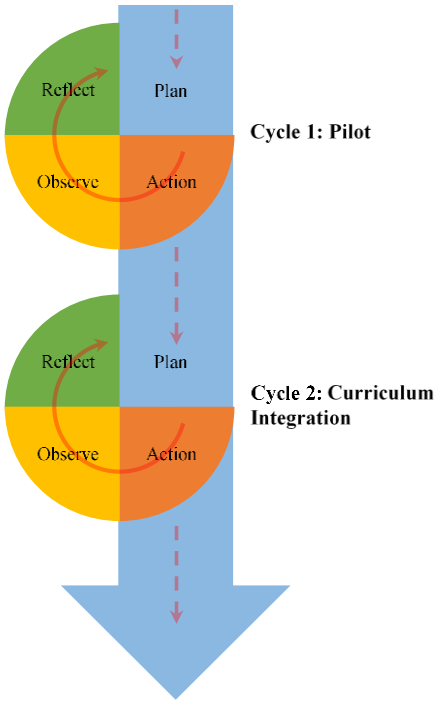

Figure 1: Action-Research methodology.

Previous work undertaken by the author [21] revealed that the learning style of yacht engineering students can be characterized as participant. According to Reichmann and Garsha [22], those students are looking to get the most out of the course, and will be willing to take part in as many activities related to the course as possible. This is extremely positive and indicates, at the planning stage of the intervention, that most students should be interested in additional resources such as micro-lecture captures with quizzes. The literature however notes that it can be difficult to engage students in vodcasts if they are not already engaged with the course [23].

3.2 FIRST CYCLE

The pilot cycle consisted of the intervention, and the very first micro-lecture capture with embedded quizzes. The primary aim was to provide a practice platform for the development of the proposed solution, but also to introduce the concept to the students. The observation phase started with a purely quantitative analysis, looking at the statistics for student engagement, as well as the viewing pattern, as presented in Figure 2.

The six minutes micro-lecture capture is composed of four quizzes:

- An entry question, just a few seconds into the micro-lecture, to immediately engage the audience.
- Two questions throughout the video, the answers to which are explicitly covered.
- An exit question, linked to the following lecture, aimed at challenging the learner's preconceived ideas about a given topic.

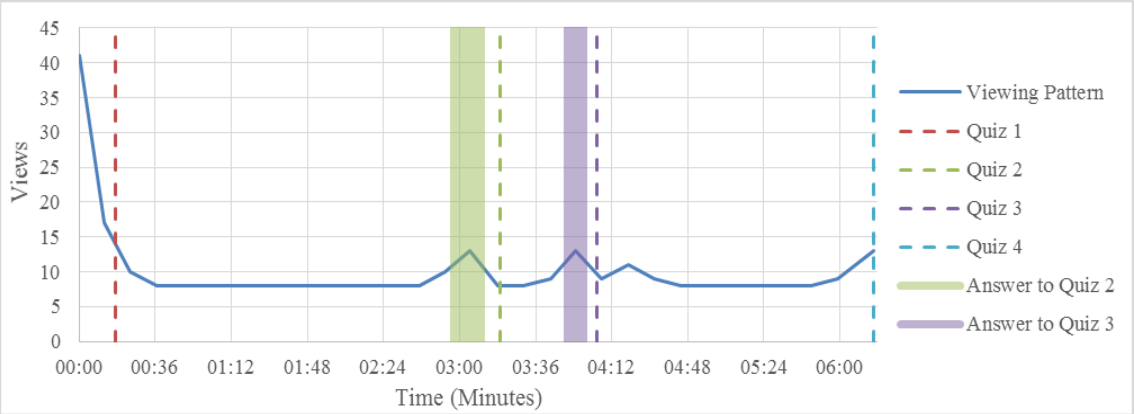

Figure 2: First micro-lecture viewing pattern, with quizzes and answers locations.

Each quiz is set up so that students are not allowed to watch the rest of the video until the question has been answered. A wrong answer will result in a message displayed on screen, typically an explanation of the correct answer, also highlighting the need for students to go back and find the answer in the video. This is a key element, as there is a rich literature relating student engagement with immediate feedback and encouragement to re-take a test immediately [24, 25, 26].

It is therefore very interesting to see a spike in the number of views where the answers to the second and third quizzes are, thus demonstrating that some students go back and look for the answers within the micro-lecture, thus engaging with the teaching material.

3.3 SECOND CYCLE

With a very clear objective of supporting students with the end goal of improving their level of understanding and grades, it is vital to integrate the micro-lectures with embedded quizzes as part of the curriculum. Moving on from the pilot which was almost a stand-alone recording, the second cycle of the action research focusses on the micro-lecture captures taking a greater place as part of the curriculum, with direct links to past, present and forthcoming material covered in the face to face sessions and on the VLE, as well as independent tasks to be carried out before the next classroom-based lecture. This also provides an answer to Leitch and Day's [10] main criticism of action research: its lack on relation with the curriculum.

The overall length of the recording was decreased to just over four minutes, with a more even spread of the quizzes, and a delayed entry question compared to the original pilot. This was primarily dictated by the informal feedback gathered as well as recommended practice in the literature for MOOCs [18]. It also promotes segmentation, with the different parts of the video presented in smaller increments, thus better guiding the students looking for particular answers [27].

The viewing pattern for the second micro-lecture capture, with the location of the quizzes and answers, is presented in Figure 3. As per the first one, the viewing pattern analysed is the number of views over the duration of the video. This is somewhat in contradiction with the literature, that typically focusses on the number of views over time, eventually relating the use of lecture capture to exam or assessment preparation [28]; this will however be presented in Section 4 and 5 when looking at implementation over a longer period of time.

Looking at the number of views, there are clear spikes at the precise times where the answer to the quizzes are, thus showing evidence of student engagement, with viewers going back over the micro-lecture capture to find the answers.

It is also worth noting that the results of the quizzes enable to identify areas of potential confusion or misunderstanding for the students, which can be covered again in the following face to face session to reinforce concepts that have not been fully acquired.

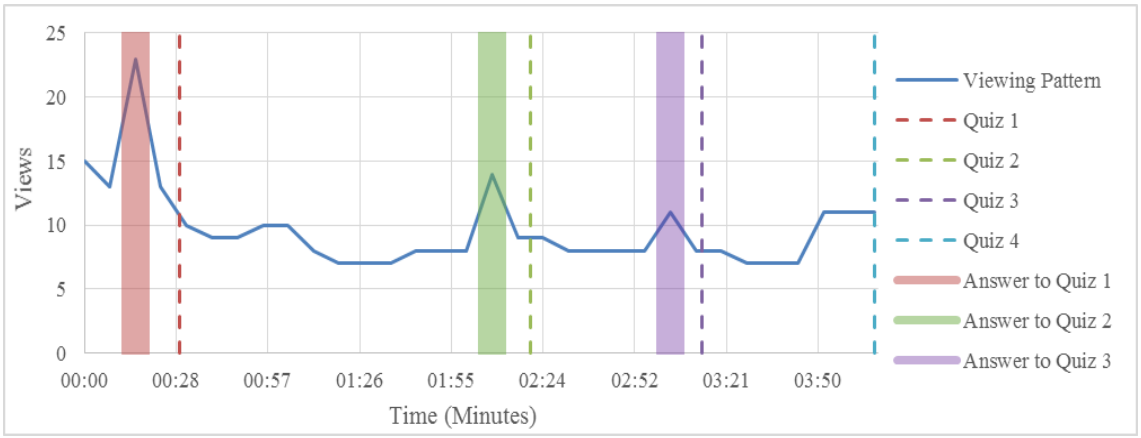

Figure 3: Second micro-lecture viewing pattern, with quizzes and answers locations.

3.4 CONCLUSIONS

At the end of the first two action research cycles, the student engagement with lecture captures has been significantly enhanced, with a very positive informative feedback, and a successful integration as part of the curriculum. This motivated further work to be undertaken, by first looking at employing this new strategy on a short course, and monitoring the use of the micro-lectures over time, in relation with key deadlines. A two weeks short course on the EMship+ Master course at the University of Liege, Belgium, was therefore selected.

4. CASE STUDY 1: MSC COURSE

4.1 EMSHIP+ MASTER COURSE

Created in 2011, the EMship+ master course in Ship Design is part of the prestigious Erasmus Mundus Joint Master Degree (EMJMD) programme, that aims a bringing together a cohort of highly diverse students, enhance the quality of higher education and promote dialogue and understanding between people and cultures through mobility and academic cooperation. In recognition for its outstanding performance, the course was later granted the Erasmus Mundus + label by the European Commission. The students are given the opportunity to study in several countries over the 18 months duration of the course. Indeed, the first semester is taught at the University of Liege, Belgium; the second at the Ecole Centrale of Nantes, France; and the third in either Germany, Poland, Romania, Italy or France. Furthermore, between the second and third semesters, students can conduct their research thesis in a partner University worldwide, such as Solent University; the universities involved in the EMship+ Master are presented in Figure 4. As of 2018, a new version of the master, extended over four semesters instead of three has been launched to attract more students. The ambition of the master is to build on diversity, with an interdisciplinary approach with exceptional depth and scope thanks to the wide range of international universities involved [29].

Figure 4: EMship+ network.

Recognising and encouraging diversity is the culmination of a long process, originally targeted a eliminating discrimination [30]. Today, diversity is about pluralism, and has become a strength that higher education is looking to exploit to its full potential, particularly in the Maritime field, as previously shown by Souppez [31], and clearly stated by Michaeli *et al.* [32]:

"The faculty capitalize on the diversity in the classrooms, which includes traditional students (high school direct to college), active duty and military veterans as well as those who have work experience and are now pursuing an engineering degree. Having a 28-year old sailor with a shipboard experience in the same classroom as a 19 or 20 years old with very little experience and a 34-year old shipyard welder working on her engineering degree brings so much more depth and peer-to-peer learning in the classroom".

This is the approach taken by Erasmus Mundus programmes, promoting student mobility and multicultural learning environments in higher education. This however raises one major challenge: how to teach such a diverse cohort of students? One of the elements to that answer resides in the use of technology enhanced learning.

4.2 TRIAL AND RESULTS

Data was gathered on the use of lecture capture, both prior to and after its two weeks trial with the students, so that the original perception could be compared to the final satisfaction. This is very much representing another cycle of action research methodology, planning and implementing a change in teaching practice, and then assessing the impact. Students were asked whether the EMship+ course should adopt lecture capture, micro-lecture captures, and provide a more technology-enhanced learning environment. The noticeable shift towards a greater satisfaction between the two surveys demonstrated the positive impact of the lecture capture technology (in both full and micro-lecture formats) as well as the benefits of the technology-enhanced learning environment experimented with during the short course.

Another finding was the greater use of the micro-lectures with embedded quizzes compared to the full lecture captures. Indeed, comparing the viewing patterns for each, depicted in Figure 5, there is a much stronger use of the micro-lectures made.

Furthermore, the viewing patterns between the delivery of the lectures and the exam is particularly interesting. The majority of the views occurred during the course, the holiday, and the week before the exam.

In all cases, a greater use of my micro-lectures was made by the students, thus providing further evidence of the rationale behind my action research experimentation with the innovative use of the lecture capture technology.

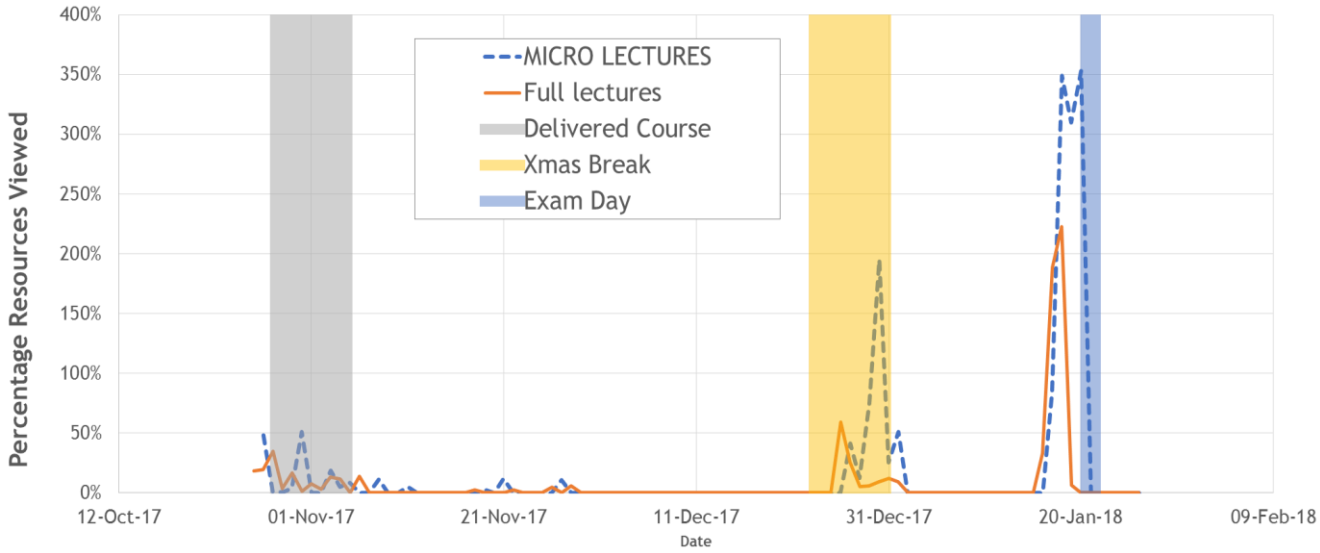

Figure 5: Viewing pattern of lecture captures and micro-lecture captures on a short course.

The novel use of lecture capture has therefore proven to be well received and appreciated by the students over a short course.

4.3 CONCLUSIONS

The acknowledgment made by higher education that diversity is a strength and should be promoted led to the creation of the interdisciplinary Erasmus Mundus Joint Master Degrees, promoting student mobility across the world and attracting a highly diverse group of students, amongst which features the EMship+ Master.

By bringing new technologies, such as lecture capture, and making innovative use of it, via micro-lectures with embedded quizzes, a more suited and engaging learning environment was created. The student survey realised before and after a two weeks trial showed the value of lecture capture as part of the course, and a significant increase in satisfaction after only a short period of implementation.

The suitability of the micro-lecture capture with embedded quizzes approach was also proven very successful has shown by the viewing patterns. Those encouraging results prompted a longer investigation, on a level 4 unit.

5. CASE STUDY 2: BENG COURSE

5.1 BENG (HONS) YACHT AND POWERCRAFT DESIGN

With yacht courses recognized as the world's leading ones, and established since 1969, the yacht design degrees at Solent University (formerly Southampton Institute) offer the full breadth and depth of small craft naval architecture knowledge [33].

The BEng (Hons) Yacht and Powercraft Design course offers some of the more challenging numerical and technical units, in the fields of structural analysis and aero-hydrodynamics. Consequently, offering additional support for the range of first year students (level 4) is crucial to the future success of their studies.

Consequently, the use of micro-lectures was employed on the Structural Mechanics unit over the 30 teaching weeks of the academic year, spanning from September to May.

5.2 TRIAL AND RESULTS

Similarly to the short implementation on the EMship + Master, both full-lecture captures (recording the entire lecture) and micro-lectures (in a 5 minutes format with embedded quizzes) were employed throughout the year. On a weekly basis, two full lecture captures were recorded (lecture and tutorial), with a single micro-lecture capturing the essence of the topic tackled this particular week.

Firstly, Figure 6 presents the overall data for the full hour long lecture captures, as a mean to assess the actual student use. While the data shows some use through the year, with peaks during the assessment and right before the summative examination, the actual quantitative use remains very limited. Indeed, as a percentage of the resources available, very little is actually being used by the students.

One element that could have contributed to this very minimal use is the more attractive use of micro-lectures. These do not only offer a more interactive learning experience, but are also more time efficient. Students can gain a very strong overview of a particular topic in a very stimulation manner in just a few minutes. The data inherent to the use of micro-lectures, plotted on top of the full lecture data in Figure 7 reveals its tremendous use by the students. The data also reveals the primary use of the micro-lecture captures as a revision tool prior to deadlines, such as formative and summative examinations and assessments.

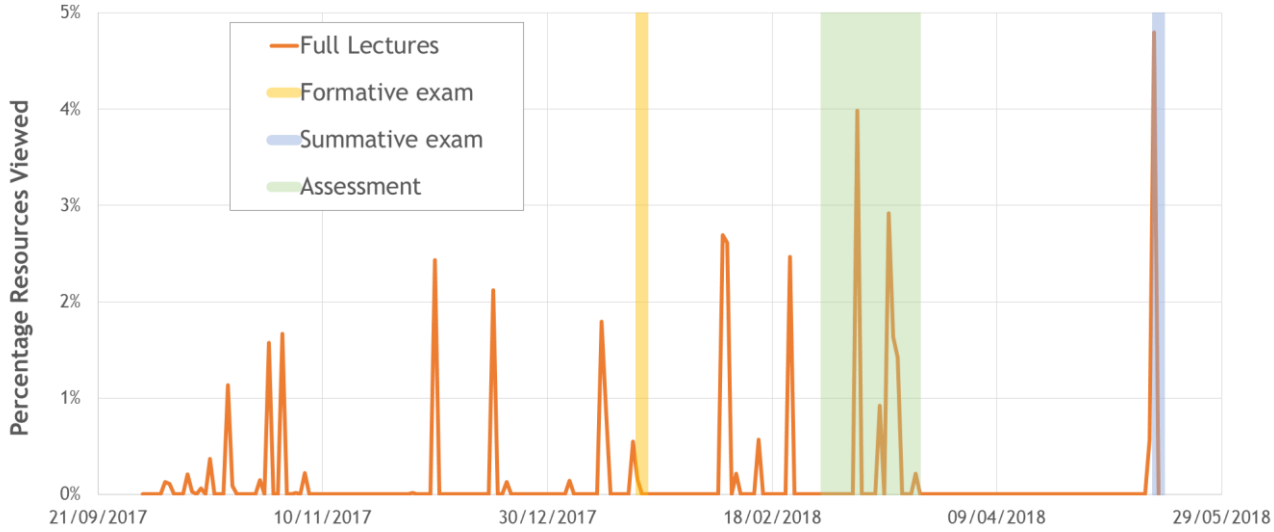

Figure 6: Viewing pattern for full lecture captures over the course on an academic year.

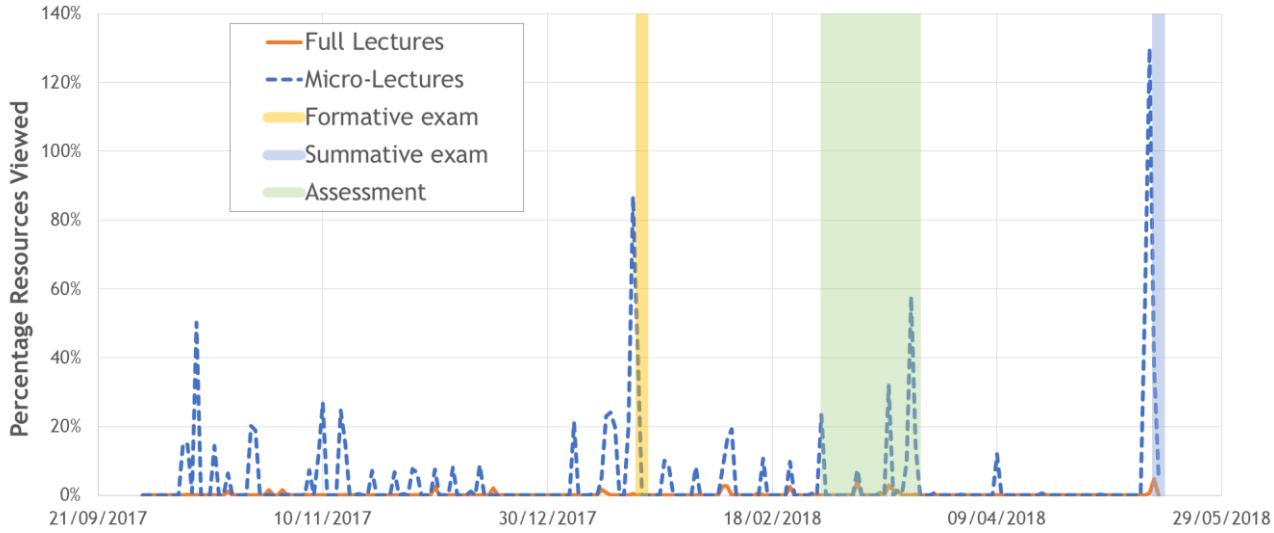

Figure 7: Viewing pattern for the full and micro lecture captures over the course on an academic year.

While the primary use the lecture captures clearly appears to be for revision purposes, there are smaller regular weekly spikes that coincide with the release of the micro-lectures. From an educator's perspective, this is providing a wealth of information, and has two main impacts on self-practice.

Firstly, the answer to the quizzes easily allows to assess which concepts have been fully grasped, and those that could benefit from further explanations. By monitoring the results of the quizzes during the week following release, it is possible to identify the needed revisions that should be made at the start of the following lecture.

On the other hand, the ability to see the individual student's performance contributes to ensuring no one is falling behind, and can help identify someone in difficulty. Indeed, if a particular student's performance does not appear sufficient, this could indicate some issues in the learning process, be it due to a language barrier, a misunderstanding, or an external factor affecting the ability to study and keep up with the work. This has proven very useful in starting a dialogue with students that could have otherwise be alienated, and ensure the individual support needed was provided.

5.3 CONCLUSIONS

Following a pilot study and implementation on a short course, the use of micro-lecture captures was trialled for a whole academic year on the level 4 Structural Mechanics unit of the BEng (Hons) Yacht and Powercraft Design. Over the course of the academic year, in addition to the normal lecture capture of the lectures and tutorials, weekly micro-lecture captures with embedded quizzes were released. Looking at the viewing pattern showed the tremendous student engagement triggered by the micro-lectures. While the learner's use was shown to be primarily for revision purposes and close to deadlines, as an educator, it is the weekly feedback from the quizzes that has the greatest impact on teaching practice.

6. CONCLUSIONS

Building on a strong literature review of technology enhanced learning through vodcast and the inherent suitability of the action research methodology, a novel use of lecture capture technology, namely micro-lecture captures with embedded quizzes were trialled over 18 months. Firstly, a pilot study was conducted in order to assess the suitability and refine the delivery of the micro-lectures thanks to both qualitative and quantitative data. Then, this was experimented with over a 2 weeks short course on a level 7 unit as part of the EMship+ Master. The very successful outcomes included a greater use compared to traditional lecture capture, and demonstrated a strong use for revision purposes. Finally, micro-lecture captures with embedded quizzes were employed over a whole academic year on a level 4 unit of the BEng (Hons) Yacht and Powercraft Design unit. Again, tremendous impact compared to traditional lecture capture was noticed, with greater use prior to deadlines. There is however a much stronger benefit from the educator's perspective when employing this strategy regularly all year long. Indeed, the results of the quizzes permit to monitor the overall progress of the cohort, as well as identify any individual struggling.

In the modern higher education context, this novel use of lecture capture technology appears very well suited to support student engagement and promote student satisfaction, while also providing frequent informal feedback to the educator, thereby ensuring the unit is delivered at the most appropriate pace, without any individual being left out, thus representing a modern inclusive practice.

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9. AUTHORS BIOGRAPHY

Jean-Baptiste R. G. Souppez holds the position of Senior Lecturer in Yacht Design and Composite Engineering at Solent University, teaching on the prestigious BEng (Hons) Yacht and Powercraft Design, BEng (Hons) Yacht Design and Production and MSc Superyacht Design. He contributes to the European Master in Integrated Advanced Ship Design (EMship+) as a Visiting Professor and Research Supervisor, and is also the UK Principal Expert in Small Craft Structures, in charge of representing the interests of the British Marine Industry in the development of international structural regulations (BS EN ISO 12215). His research in fluid dynamics features twisted flow wind tunnel, towing tank, wave and current flume, particle image velocimetry, laser doppler anemometry, and full size instrumented testing, as well as a range of numerical methods.