

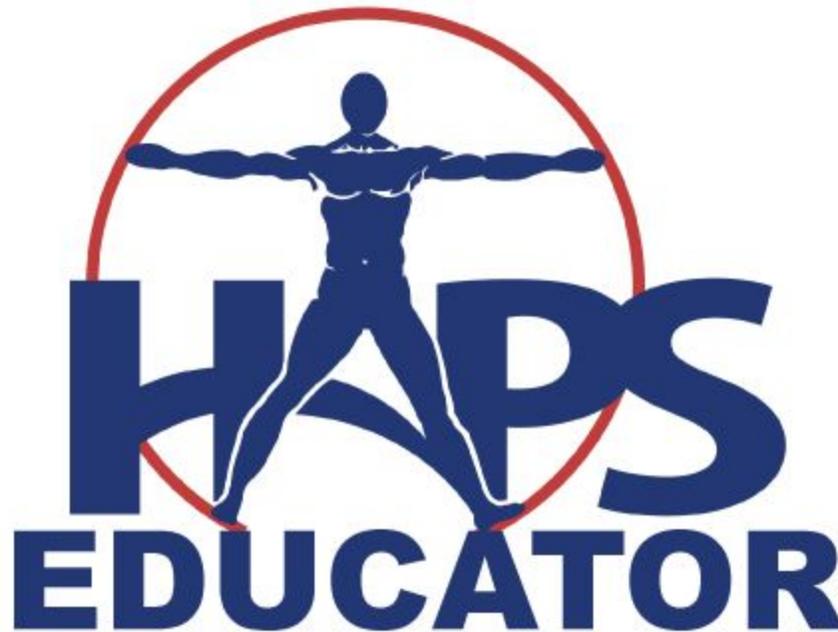
**Lecture Capture Technology (LCT): Following Some Rules and Breaking Others.
The Advantages, Perks, and Pitfalls of LCT Implementation in Large Human Anatomy,
Physiology, and Pathophysiology Classrooms**

Zoë A Soon* and Heather Hurren

*Corresponding Author: zoeanne.soon@ubc.ca

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Lecture Capture Technology (LCT): Following some rules and breaking others. The advantages, perks, and pitfalls of LCT implementation in large human anatomy, physiology, and pathophysiology classrooms.

Zoë A Soon, PhD^{1,3} and Heather Hurren, M.Ed^{2,3}

¹School of Health and Exercise Sciences, Faculty of Health and Social Development

²Centre for Teaching and Learning

³University of British Columbia Okanagan, Kelowna, BC, V1V1V7

Corresponding Author: Zoë Soon

zoeanne.soon@ubc.ca, heather.hurren@ubc.ca

Abstract

There is much in the literature about the perks and pitfalls of introducing lecture capture technology (LCT) into the classroom, with recommendations and guidelines as well as mixed reports outlining the ensuing expected and unexpected, in terms of positive and negative outcomes. With the goal of providing another student study resource, LCT was introduced into five large anatomy, physiology, and pathophysiology courses at the University of British Columbia Okanagan. Some literature guidelines were followed, including: i) introduce LCT into content-heavy, lecture-based courses, ii) make LCT easy to use for students, iii) make recordings annotated and interesting, and iv) provide enough in-class activity to prevent drops in attendance. Other guidelines were not followed, for example: i) keep videos novel, short, and focussed on problem areas; ii) conduct mid- or post-video tests; and iii) provide to first-years but not upper-years. This paper details LCT's merits and drawbacks for very different cohorts across three years of an undergraduate program. doi: 10.21692/haps.2018.001

Key words: physiology, lecture capture, student engagement

Introduction

Lecture capture technology (LCT) has become more robust and popular at universities and colleges over the last ten years. In addition, the ability to implement this technology in both large and small classrooms has become more feasible in a variety of different settings. As a result, there has been much study on whether adapting lecture capture (LC) positively affects learning and what best practice should entail. Thus far, studies in the literature have attempted to answer the following questions:

1. Does LC positively affect learning?
2. Is LC an effective substitute for face-to-face lectures?
3. Does LC lead to absenteeism?
4. Which students benefit the most from LC?
5. Do students believe LC is beneficial to their learning?
6. Do faculty believe LC is beneficial to their students' learning?

1.1 Does LC positively affect learning?

A meta-analysis by Danielson *et al.* (2014) indicates that results in the literature are mixed. Some studies found that there was no clear relationship between learning outcomes and lecture capture use (Spickard *et al.* 2002, Solomon *et al.* 2004, Brotherton and Abowd 2004, Bacro *et al.* 2010, Franklin *et al.* 2011). Other studies have reported mixed or negative effects (McNulty *et al.* 2009, McNulty *et al.* 2011, Owston *et al.* 2011,

Fernandes *et al.* 2012). However, positive results have also been reported (Bridge *et al.* 2009, Dey *et al.* 2009, von Knosky *et al.* 2009, Elsasser *et al.* 2009, Inglis *et al.* 2011, and Shaw and Molnar 2011).

Specifically in studies with positive outcomes, researchers found that students who both attended face-to-face lectures and devoted time to reviewing LC recordings had higher exam results on average than students who only attended face-to-face lectures, or who only learned material through lecture videos or other resources (e.g. tutorial sessions). Such studies reporting positive outcomes were conducted in a variety of large undergraduate courses and include: Williams *et al.* 2012 study of a 1st-year Microeconomics Principles class; Wieling and Hofman's 2010 study of a European Law course, Danielson *et al.*'s 2014 study of veterinarian classes, and Stockly and Hemley 2017 five-year study of an Economics course.

Overall, the mixed results reported in the literature suggest that LC can have a positive effect on learning in the right set of circumstances.

1.2 Is LC an effective substitute for face-to-face lectures?

Again the literature's answer to this is mixed. Several studies have shown that students that use lecture capture recordings

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instead of attending live lectures have lower exam results. However, non-attendees that watched LC did have better exam results than students who neither attended class nor watched the videos (Inglis *et al.* 2011, Williams *et al.* 2012, Nordmann *et al.* 2018). As a footnote, it should be mentioned that a reported limitation of these studies was that the attendance and viewing data may be subject to inaccuracies. Attendance data and LC viewing data gathered was either student self-reported or through the technologies' tracking systems, which reported the number of LC views but did not report number of minutes viewed. Therefore, it was impossible to know whether number of "views" logged, were by students watching the LC to completion, or for just for a few seconds (Nordmann *et al.* 2018). Therefore it could be that low marks are not due to LC being a less effective substitute, but more due to low effort (poor attendance and ineffective lecture capture review).

Of course, it should also be mentioned that in other studies, LC recordings were actually found to be a good substitute for face to face lectures, with students performing equally well in both experimental groups (i.e. face-to-face and lecture capture) (Spickard *et al.* 2002, Solomon *et al.* 2004, Wieling and Hofman, 2010). In particular, LC was deemed an effective substitute for live lecture, for students with a high GPA (Inglis *et al.* 2011).

Given the mixed results, it is speculated that there are likely several factors that determine whether LC can and will be used as an effective substitute of face-to-face lectures by the students. It was noted that students are more likely to review lecture captures if the course is lecture-based instead of activity-based, if the quality of the lecture recording is good, if the students are motivated and have educational maturity, and if other course resources do not provide the same material (Cardall *et al.* 2008, Danielson *et al.* 2014).

1.3 Does lecture capture lead to absenteeism?

As might be expected, LC did lead to absenteeism in some (but definitely not all) studies (Bell *et al.* 2001, Powers and Carroll 2017, Rahmann *et al.* 2018). Unfortunately, Bell *et al.* (2001) found that students were skipping class with the intention of accessing the lecture captures at a later date, and then not actually finding the time to do that, possibly contributing to their lower outcomes.

In 2017, Powers and Carroll studied the effects of LC usage over the span of two years in a pharmacology course for 2nd-year medical students. They found that attendance for each class was low, 25-31% (in a class of ~200) students and only 12-14% of students exhibited a high attendance level (attending >80% classes). The researchers attributed this low attendance to the availability of posted lecture captures. Similarly to Bell's study, they found that poor attendance correlated with lower exam results. Whereas students with high attendance had significantly higher exam scores within the course, as well as

22 weeks later in a comprehensive National Board of Medical Examiners (NBME) exam.

However, there are things that look very promising for maintaining attendance. In most studies, as examined in the meta-analysis performed by Danielson *et al.* (2014), attendance was not affected by the addition of lecture capture. Likewise, in 2018, Nordmann *et al.* found that there was no relationship between attendance and recording use. Moreover, in Nordmann's study, GPA, attendance, and recording use were all positive and synergistic predictors of high exam marks. In search of reasons for why student attendance is maintained in many courses, Rahmann *et al.* (2018) surveyed his engineering students. Eighty percent of the engineering students stated that LC technology is not sufficient on its own, especially if there are drawings, demos, student discussion, Q&A, or other activities in lecture that are not captured through the recording. This indeed is the drawback for most LC platforms as the camera typically only records the computer screen and the microphone only picks up the instructor's voice.

In Rahmann's study, 40% of the engineering students had previously taken courses with LCT so it was felt that they had a good understanding of the technology and its pros and cons. That comfort level could be seen in the survey results, as this subset of students stated they were more likely to believe that LC could fulfill most of their study needs rather than attending lectures. However it appears that despite this belief, these students did not stop attending class. Attendance was actually maintained throughout the term at ~93% which was similar to previous years prior to the addition of lecture-capture.

Thus as with Rahmann's engineering courses, if attendance and student-teacher interaction is perceived to be beneficial to the learner, instructors are advised to take steps that ensure attendance, perhaps by including activities, demos, group work, problem solving, assignments, and/or quizzes during class time. In addition, students were more likely to attend classes that were efficient and well-taught making it time well spent.

In sum, there were two common factors that might be used to predict whether a drop in attendance would occur with the adoption of LC. 1) Courses with attendance drops were exclusively lecture-based courses and 2) Upper-year or post-graduate students were more likely to routinely skip classes when LC was available. In explaining these results, it was thought that these more experienced students were likely more educationally mature with better meta-cognition (though still over-confident). In addition, these students were more likely to succeed in these courses despite possibly having lower marks than if they had attended as well. (Powers and Carroll 2017).

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1.4 Which students benefit the most from LC?

There are a few theories as to which students will likely benefit the most from lecture capture. In 2007, Phillips *et al.* believed that first-year students would be less likely to attend lecture or access recordings due to immature metacognitive abilities and learning strategies. At the same time, Demetriadis and Pombortsis (2007) speculated that first-year students would actually benefit the most from lecture capture as introductory courses tend to focus on knowledge acquisition instead of the higher order thinking skills, such as problem solving and applied knowledge, that are central to 3rd and 4th year courses. In their study of first year students, Demetriadis and Pombortsis (2007) found that students taught in the control group via live-lecture had the same outcomes as students taught via LC. Though in a conscious effort to make sure students adhered to using LC in that group, they used short 8.37 minute e-lectures and implemented pre-tests and post-tests (consisting of open-ended questions) as well as requiring post-viewing student teacher meetings. During the meetings students were asked six review questions and were expected to pose their own questions to the instructor.

In a meta-analysis of the literature, Danielson *et al.* (2014) found that students were most likely to view and benefit from LC in courses that were fast-paced, relied heavily on lecture, were perceived as being important and relevant to their future, and were comprised of novel information not available in other formats. Furthermore, students were more likely to view captured lectures if all of the instructor's annotations were recorded (e.g. digital ink was used instead of laser pointer). Along the same lines, classes that involved group work or hands-on work were less likely to be classes that students would view via lecture capture as much of that work would be missed in the recording. Additionally students felt they were more likely to view captured lectures, if the instructor was skilled in explaining material, rather than just reading from their slides. It was also noted that lectures that were disorganized would be more likely to be viewed in order to help with clarification.

In sum, if it is desirable that lecture captures are used by students for review or in flipped or web-based learning classes, there are a few recommendations in producing them: a) make short videos on challenging content, b) make videos with embedded questions that must be answered, c) make videos that have testable content, that are novel and not found in other student resources, d) make sure videos are well organized and posted in an organized manner that is user-friendly, e) have post-tests or post-student-teacher meetings to discuss the videos (Demetriadis and Pombortsis 2007, Danielson *et al.* 2014).

When thinking about whether live-lecture or lecture capture is the most beneficial for students, it is also worth considering a study by Varao-Sousa and Kingstone (2015) who found that their students performed better in short-term memory tests if

they attended live-lecture rather than watched lecture videos. In addition, they found that students found the material less interesting and were less motivated when the material was on video lecture rather than live lecture suggesting that having a live professor and possibly a particular setting involving other students, is important in student engagement and learning (Gysbers *et al.* 2011, Varao-Sousa and Kingstone 2015).

1.5 Do students believe LC is beneficial to their learning?

All studies found that access to some form of recorded lecture (webcast, videos, clips) increased student satisfaction (Ingilis *et al.* 2011, Gosper *et al.* 2008, Davis *et al.* 2009, Folley 2010, Le *et al.* 2010). Students appreciated the flexibility of having LC available and having a choice in their learning approaches (Mattick *et al.* 2007). Students appreciated having the extra resources even if they didn't use them. Furthermore, having ready access to a good "back-up" in case they did need help with clarification, review, or missed lecture was valued and even alleviated anxiety in some cases (Danielson *et al.* 2014, Kay 2012). When surveyed in these and the following studies, the four main reasons students cited for wanting access to LC is:

- a. **Clarification:** Lecture recordings that have fast forward, double speed, and replay options can be skimmed through to review sections for clarification (Leadbeater *et al.* 2013).
- b. **Learning:** Lecture recordings can be accessed and used at an individualized pace, and in a chosen environment (perhaps less distracting or alongside a tutor, sign language interpreter, or learning assistant) and in a time that better suits the student's personal learning and scheduling. In this way LC assists with ownership of learning and making time spent more efficient and productive. Lecture recordings specifically with pause and replay features were found to be helpful to ESL (English as a Second Language) students and students with physical or learning disabilities (Simpson 2006, William 2006, Pearce and Scutter 2010, Nordmann *et al.* 2018).
- c. **Revision:** Lecture recordings can be used for revision (Winer and Cooperstock 2002, Brotherton and Abowd 2004, Scutter *et al.* 2010).
- d. **Catch-up:** Lecture recording can be used for making up missed sessions or to catch-up on things missed in class (Wilson and Weiser 2001, Taplin *et al.* 2014, Eisen *et al.* 2015). Interestingly, Rahman *et al.* (2018) found students can have difficulty maintaining attention during face-face lectures. In which case, students found that reviewing lecture recordings was helpful making it possible for them to fill in or clarify gaps in their notes. Moreover, lecture recordings were also cited as being helpful during periods of the day when student mind concentration level is low (afternoons and evenings) and also when the course was found to be difficult (Rahman *et al.* 2018). It was also noted that lecture recordings are helpful for students whose

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personal obligations affected their ability to attend or concentrate during class. In addition, most students believe that they can learn just as well using web-based learning technologies (e.g. LC) as face to face lectures. (Williams *et al.* 2012)

1.6 Do faculty believe LC is beneficial to their learning?

Danielson *et al.* (2014) found that faculty perception on the value of LC on learning was somewhat more muted in comparison with the students. Students were extremely positive, with 93% of students indicating that they were very or somewhat likely to learn better with lecture capture. In contrast, only 36.4% of faculty felt that LC would be somewhat or very likely to help students learn better, and 45.5% of faculty indicated that LC would be unlikely to affect learning. Faculty had 3 main concerns:

- a. **Drop in attendance affecting student learning and classroom dynamic:** Some faculty worried that a drop in attendance may occur and affect the classroom dynamic and therefore the ability of the instructor.
- b. **Students doing less and achieving less:** In addition, it was seen as a risk that students would skip class and then not make time for LC or not learn as well through LC.
- c. **Spending time creating resources that students do not use or need.** Guy *et al.* (2017) found that the short eight to ten minute interactive video clips focusing on difficult content was accessed by only 50% of the cohort even though the student feedback was very positive. Students stated that the clips were engaging, assisted understanding of course content, and provided lecture support. Guy *et al.* (2017) found that the clip usage did correlate with higher exam marks though were not sure whether GPA or more self-regulation were the main factors in the deeper learning and higher outcomes.
- d) **Students believe it is helpful, but what if more of the same, is just more of the same, and not helpful?** This potential problem is one that may be difficult to predict and discern for both faculty and students until the term is over. Nordmann *et al.* (2018) studied the effect of LC when offered across four years of an undergraduate degree programs. Firstly and perhaps not surprisingly, they found that the achievements of honours students did not seem affected by attendance or recording use. High-achieving, upper-year students are typically motivated and have acquired better metacognition and educational maturity. As expected, Nordmann *et al.* did however find that both attendance and recording use correlated positively with performance in first-year students and to a lesser degree in second-year students. In fact, in both first-year and second-year students, they found the greatest benefit of lecture recording use was by students with a low incoming GPA that had high attendance. Additionally they found that higher-achieving students were able to use recordings as a substitute for low attendance. Remarkably though,

high recording usage and high attendance by students with a high incoming GPA, correlated with lower grades in the course, indicating that these students were struggling with the content and the recordings were not as helpful as one would have wanted them to be for these students.

As one might expect, there are a few theories that try to explain why some students benefit from certain educational resources and why some students do not. On the surface, it appears that students have different preferences in terms of which materials they wish to use in their learning (live lectures, textbooks, readings, demos, hands-on activities, group work, videos, etc.) (Kolb 1976, Marriott 2002). In addition, it is thought that some students prefer to learn while actively engaged, while others prefer to learn through the reflective processing (Kolb 1976, Marriott 2002). It has also been noted that each student's learning style preferences may be different depending on the subject, and also may change over time as the student progresses in their learning, builds up experiences, and matures (Kolb 1976, Marriott 2002). In addition, students have a whole myriad of other factors in their lives which may play a role at any point in time (e.g. can they afford a textbook or access to the internet, do they have excessive demands on their time or attention with family or job, etc.). Of course there are limitations to the studies mentioned thus far as well as this one. In most cases students are not randomly assigned to only have access to specific resources. Secondly, if the measure of success is exam performance, is this an accurate reflection of their learning and is the learning deep or superficial, long-lasting or short-lived?

Purpose

Recording and posting lectures for students has many potential benefits. It may serve as a supplemental resource that may prove helpful for students who miss something during class or would like to review a challenging topic again on their own time. Most anatomy, physiology, and pathophysiology courses are fairly fast-paced delivering a lot of content. In addition, anatomy, physiology, and pathophysiology lectures are typically designed to help demonstrate or explain information found in course readings, possibly even providing more or additional information than what is found in course textbooks. So a resource that allows the lecture to be replayed could definitely prove valuable to students.

In addition, with early morning classes in a wintery climate, of course there are times that students are not fully awake or have difficulties arriving on time due to the weather. In these cases, LCT could provide a safety-net for students. With large classrooms, LCT can also provide benefits for students who would like to meet with the instructor for review sessions or office hours, but whose schedules at times does not permit it, due to work, course, family, or other obligations.

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The potential negatives of introducing such a resource is that students may stop attending class with the belief that reviewing lectures on their own time is possible and then not follow through with the review. As mentioned in the literature, a student may be tempted to put off viewing the recordings until too late in which case the number of videos becomes overwhelming. Another risk in skipping class with the intention of viewing the recorded lecture, is of course the potential for the LCT recording device to fail on that day preventing a recording from being captured and posted. LCT relies on classroom Wi-Fi to be working as well as the microphone and recorder and podium computer. The goal of this study was to assess the implementation of LCT into five different courses across three years of a four-year degree program, and determine whether the differing factors and layout of each course would support successful adoption.

Methods

Course Descriptions

This study was approved by the UBC Behavioral Research Ethics Board (Ethics Certification: H13-02-39) and informed consent was obtained from all participants. The study focused on assessing the implementation of LCT in five courses with content in the fields of human anatomy, physiology, and pathophysiology. The courses studied took place in the 2016-2017 academic year and are within two four-year university degree programs (Bachelor of Human Kinetics, BHK, and Bachelor of Science in Nursing, BSN). Four of the courses are within the Human Kinetics program. Those courses were: first-year Anatomy and Physiology Level I (180 students, HMKN190, fall semester), first-year Anatomy and Physiology Level II (174 students, HMKN191, winter semester), second-year Lifespan Motor and Physical Development (179 students, HMKN203, winter semester), and third-year Pathophysiology (152 students, HMKN335 fall semester). The fifth course, second-year Pathophysiology for nursing students (117 students, HINT231, fall semester) is in the Nursing program. The vast majority of students in all five courses are 18 to 21 years of age. All courses are lecture based and the two first-year anatomy and physiology courses

also have weekly labs. Therefore, students enrolled in these courses attended a lecture section that met either 2x80min./week (HMKN190, HMKN191), 3x50min./week (HMKN203), or 1x160min./week (HINT231). The two Pathophysiology courses (HMKN335 and HINT231) differ in scope. HMKN335 covers major diseases and disorders of four organ systems: Musculoskeletal, Respiratory, Cardiovascular, and Neurologic Systems. HINT231 is a more intense course that covers major diseases and disorders of all organ systems.

Research Method:

It was desired that LCT be implemented in these five heavy core courses to provide additional student study resources. At the same time, the goal was to assess the effectiveness and value of such a tool in classes that differ in depth on the Bloom's taxonomy scale, as well as in levels of student maturity, metacognition, and workload. As such, LCT was implemented in each of the five courses (HMKN190, HMKN191, HMKN203, HMKN335, and HINT231), with lectures recorded using MediaSite and a portable microphone worn by the instructor to ensure both instructor's screen and voice, and could accommodate movement and activity. Each of the courses is predominantly lecture-based but also include daily practice questions, electronic device (e.g. lap top or cell phone) Q&A time, demos, and hands-on activities. Demos and hands-on activities were not recorded as per the limitations of such software. The instructor did repeat student questions and answers so they were overlaid on to the visual recordings of the moment. These audio-visual lecture recordings were posted to the respective course websites immediately after each class. Attendance was not mandatory but was recorded in HMKN190 and HMKN191. In addition, all students in each course were surveyed at the end of term. After the fall semester, HMKN190 students move on to take HMKN191 in the winter semester, so were surveyed only at the end of HMKN191. The surveys assessed student perspective on LCT use and value as well as that of other class activities in order to gain perspective on how students viewed all of these resources (Figures 1-4). The surveys were as follows:

FIRST-YEAR ANATOMY AND PHYSIOLOGY (HMKN190/191) STUDENT SURVEY:

1. I listened to some of the Recorded Lectures at least once.
2. I listened to most of the Recorded Lectures at least once.
3. I found the Recorded Lectures helpful for reviewing the material.
4. I found the Recorded Lectures helpful, because I could view it at my own pace.
5. I found the Recorded Lectures helpful, because I could view it at a time that was convenient to me.
6. I would rather have Recorded Lectures than in-class lectures.
7. Having the Recorded Lectures was valuable, because there is a lot of content in this course.
8. The Recorded Lectures were a useful part of this course.
9. The Recorded Lectures were easy to use.
10. The Recorded Lectures suits my way of learning.
11. I prefer learning through Recorded Lectures rather than reading the textbook.
12. I would rather come to class than learn through Recorded Lecture.
13. I felt more engaged in the class material because Recorded Lectures Technology was used.
14. Recorded Lectures should be used in this course in the future.
15. I think the practice questions given to us in the on-line quizzes on Connect were helpful.
16. I think the practice questions and other textbook resources were helpful in learning and studying the topics in this course.
17. I believe that the practice questions presented at the beginning of class were helpful.
18. I like to use an electronic device in class for course material.
19. I found the textbook helpful in learning studying the topics.
20. I kept up and reviewed the Lecture Material each week.
21. I found the Poster Scavenger Hunt Challenge increased the level of student interaction and discussion in our lab.
22. I think an hour of tutorial per week for this class would be helpful.
23. I would have attended an hour of tutorial per week for this class if it was run by an SL leader.
24. I would have attended an hour of tutorial per week for this class if it was run by the course instructor.

Figure 1. First-Year A&P Human Kinetics Student Survey. The students were given this optional 6-point Likert scale survey at the end of term which was completed by 94 consenting students.

FIRST-YEAR ANATOMY AND PHYSIOLOGY (HMKN190/191) STUDENT SURVEY:

1. I listened to some of the Recorded Lectures at least once.
2. I listened to most of the Recorded Lectures at least once.
3. I found the Recorded Lectures helpful for reviewing the material.
4. I found the Recorded Lectures helpful, because I could view it at my own pace.
5. I found the Recorded Lectures helpful, because I could view it at a time that was convenient to me.
6. I would rather have Recorded Lectures than in-class lectures.
7. Having the Recorded Lectures was valuable, because there is a lot of content in this course.
8. The Recorded Lectures were a useful part of this course.
9. The Recorded Lectures were easy to use.
10. The Recorded Lectures suits my way of learning.
11. I prefer learning through Recorded Lectures rather than reading the textbook.
12. I would rather come to class than learn through Recorded Lecture.
13. I felt more engaged in the class material because Recorded Lectures Technology was used.
14. Recorded Lectures should be used in this course in the future.
15. I think the practice questions given to us in the on-line quizzes on Connect were helpful.
16. I think the practice questions and other textbook resources were helpful in learning and studying the topics in this course.
17. I believe that the practice questions presented at the beginning of class were helpful.
18. I like to use an electronic device in class for course material.
19. I found the textbook helpful in learning studying the topics.
20. I kept up and reviewed the Lecture Material each week.
21. I found the Poster Scavenger Hunt Challenge increased the level of student interaction and discussion in our lab.
22. I think an hour of tutorial per week for this class would be helpful.
23. I would have attended an hour of tutorial per week for this class if it was run by an SL leader.
24. I would have attended an hour of tutorial per week for this class if it was run by the course instructor.

Figure 2. Second-Year A&P Human Kinetics Student Survey. The students were given this optional 6-point Likert scale survey at the end of term which was completed by 104 consenting students.

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SECOND-YEAR NURSING PATHOPHYSIOLOGY (HINT231) STUDENT SURVEY:

1. I listened to some of the Recorded Lectures at least once.
2. I listened to most of the Recorded Lectures at least once.
3. I found the Recorded Lectures helpful for reviewing the material.
4. I found the Recorded Lectures helpful, because I could view it at my own pace.
5. I found the Recorded Lectures helpful, because I could view it at a time that was convenient to me.
6. Having the lecture recording was valuable, because I found the three hour class too long.
7. I found the 3 hour class is too long.
8. I think this class would be better if it was twice a week (2x 80min) rather than once a week (1x180min).
9. The Recorded Lectures were a useful part of this course.
10. The Recorded Lectures were easy to use.
11. The Recorded Lectures suits my way of learning.
12. I prefer learning through Recorded Lectures than reading a textbook.
13. I attended all 3 hours of each class, this term.
14. I would rather come to class than learn through Recorded Lecture.
15. I felt more engaged in the class material because Recorded Lectures Technology was used.
16. I like using an electronic device in class for course material.
17. Recorded Lectures made me feel comfortable learning and reviewing new material.
18. Recorded Lectures should be used in this course in the future
19. I found the "Think About" and "End of Slideshow" questions in this course helpful
20. I found it was helpful when the instructor provided the Answers to the "Think About" and "End of Slideshow" questions.
21. The Endocrine Videos (e.g. Diabetes, Cushing's, Thyroid Hormone) shown in class and posted to Connect were helpful.
22. The Digestive System Video apps shown in class were helpful. (Those ones are not able to be posted to Connect)
23. I kept up with Lecture Material each week.

Figure 3. Second-Year Nursing Student Survey. The students were given this optional 6-point Likert scale survey at the end of term which was completed by 67 consenting students.

THIRD-YEAR HUMAN KINETICS PATHOPHYSIOLOGY (HMKN335) STUDENT SURVEY:

1. I listened to some of the Recorded Lectures at least once.
2. I listened to most of the Recorded Lectures at least once.
3. I found the Recorded Lectures helpful for reviewing the material.
4. I found the Recorded Lectures helpful, because I could view it at my own pace.
5. I found the Recorded Lectures helpful, because I could view it at a time that was convenient to me.
6. I would rather have Recorded Lectures rather than in-class lectures.
7. Having the lecture recording was valuable, because there is a lot of content in this course.
8. I listened to the Recorded Lectures each week.
9. The Recorded Lectures were a useful part of this course.
10. The Recorded Lectures were easy to use.
11. The Recorded Lectures suits my way of learning.
12. I prefer learning through Recorded Lectures than reading a textbook.
13. I would rather come to class than learn through Recorded Lecture.
14. I felt more engaged in the class material because Recorded Lectures Technology was used.
15. Recorded Lectures should be used in this course in the future.
16. I like using an electronic device in class for course material.

Figure 4. Third-Year A&P Human Kinetics Student Survey. The students were given this optional 6-point Likert scale survey at the end of term which was completed by 110 consenting students.

During data analysis, the following questions were addressed:

- a. Do students use the LCT recordings? If so, how much?
- b. Is there a difference between classes in how much the LCT recordings are used?
- c. Do students find LCT valuable, easy to use, convenient, and/or helpful?
- d. Do students appreciate LCT as much as other class activities: practice questions, in-class assignments, and use of electronic devices for Q&A?
- e. Is there a correlation between perceived LCT value and appreciation of other class activities?
- g. Is there a correlation between exam grades and perceived LCT value (or usage)? Is LCT of more value to low-scoring students?
- f. Is there a correlation between attendance and perceived LCT value (or usage)?
- h. Is there a correlation between attendance and course grades?
- j. Is attendance affected by the use of LCT?
- i. Does gender play a role in the perceived value of LCT?

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Results and Discussion

Evaluation of Student Use of LCT

The number of views of LCT was tracked anonymously through MediaSite software and can be viewed on the software's dashboard. In addition, the time-points within the recording that are viewed are also tracked, as well as the length of time (number of minutes) that each recording is viewed. At the

end of term, this anonymous data was collected for each class and plotted (Figures 6-9). Firstly, as anticipated, it was found that most students did not view the entire recording for each lecture. Typical examples of viewing habits are documented in Figure 5. It is noted that students were selective and would view specific sections throughout the recording, unique to their own preferences.



Figure 5. Typical examples of student LCT viewing habits in this study.

Specifically, each viewing student accessed on average about 17-37% of the entire recording, indicating that they were focusing on sections that they felt they needed to review or clarify. First-year students viewed the fewest number of minutes on average per recording (at 17-18% or 11-12 min.) (Figure 4). Their viewing habits increased between Term 1 and Term 2, possibly as they became more acclimatized to the university setting, or through friend-referral and/or assistance. It is also possible that students began to appreciate LCT as a study resource over time, or developed greater metacognitive skills that led to the inclusion of more study resources in their study plan. Attendance did drop slightly in Term 2 (by 10%), which is historically typical. The drop would only accounts for about half the increase in LCT viewing, if there was a specific relationship.

Third-year students viewed a few more minutes per recording, averaging 22-25% (15-17 min.) of each recording (Figure 7). Second-year students viewed the greatest percentage of each recording, on average at 31% in HMKN203 and 29% in HINT231 (Figures 5 and 6). In terms of number of views, the third-year students recorded the highest number of views per student (92% of the class); followed by HMKN191 (71% of the class); followed by HMKN203 (63% of the class) and lastly HINT231 (37% of the class). This is assuming that one view translates into one viewing student, though it is of course possible that one student accessed the same recording multiple times. This illustrates one limitation of the study, in that MediaSites' tracking abilities are anonymous, which means that the number of views by each specific student is not recorded.

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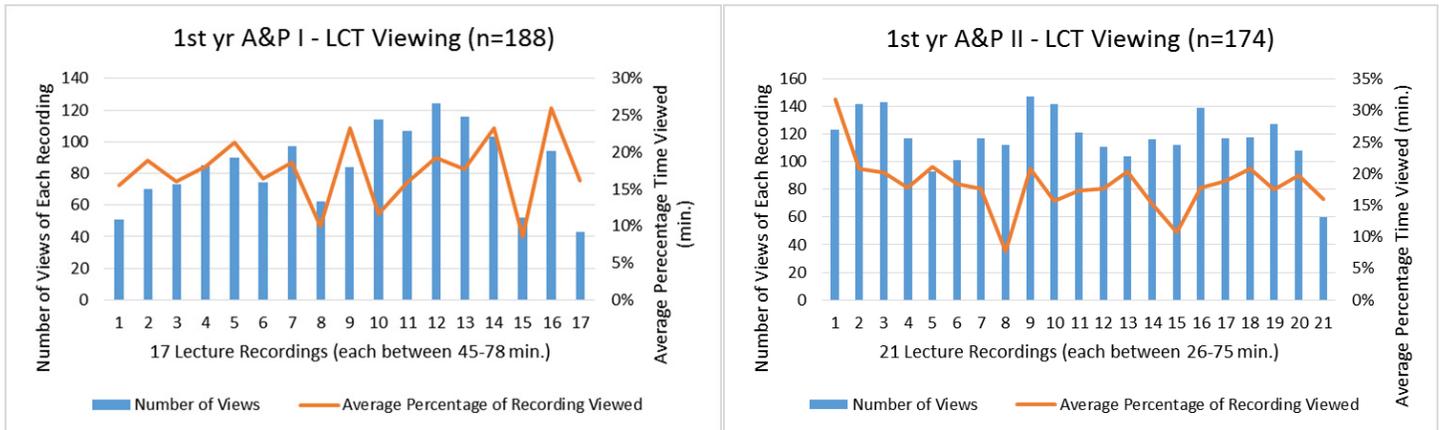


Figure 6. First-Year Anatomy and Physiology Human Kinetics Student LCT Viewing Data. a) Students in term 1 (HMKN190) recorded 85 views per recording on average and watched approximated 11 min. (17%) of each recording. If the 85 views translates to one view-per-student that implies 45% of the class utilized this LCT study tool each day. b) Students in term 2 (HMKN191) recorded 118 views per recording on average and watched approximated 12min. (17%) of each recording. If the 118 views translates to one view-per-student that implies 71% of the class utilized the LCT study tool each day (a 26% increase from Term 1). It was also noted that LCT usage is fairly consistent throughout each term.

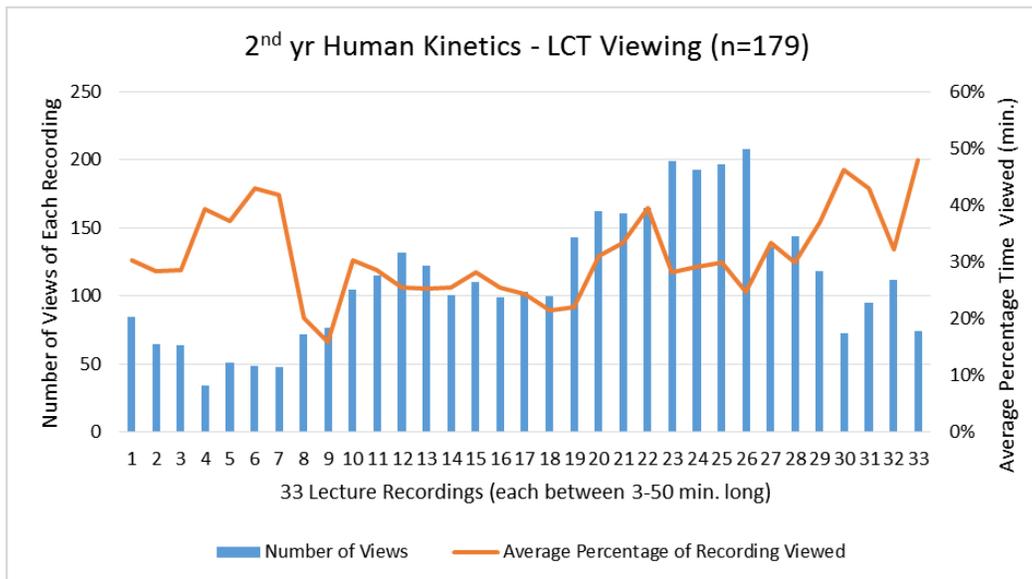


Figure 7. Second-Year Human Kinetics Student LCT Viewing Data. Students in HMKN203 recorded 112 views per recording on average and watched approximated 12min. (31%) of each recording. If 112 views is one view-per-student that implies 63% of the class utilized the LCT study tool each day. It was noted that LCT usage increases as the term progresses, with a drop in the last two weeks. There are at least two possible reasons for this trend. The drop may be due to students getting busier with end of term of assignments and exams. It may also reflect the difficulty levels in course content as most students find the middle section of this course the most difficult.

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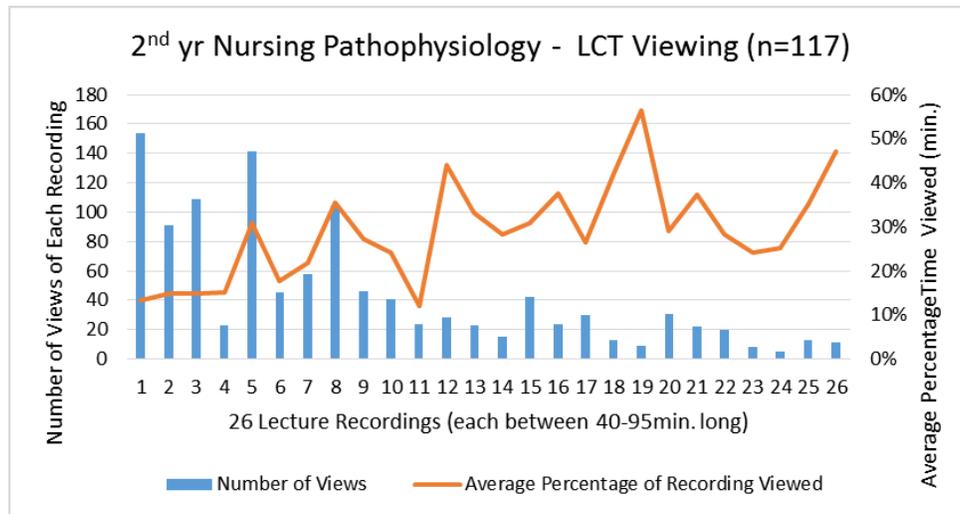


Figure 8. Second-Year Nursing Student LCT Viewing Data. Students in HINT231 recorded 43 views per recording on average and watched approximated 19min. (29%) of each recording. If 43 views is one view-per-student that implies 37% of the class utilized the LCT study tool each day. It was noted that LCT usage decreases quickly as the term progresses. There are at least two possible reasons for this trend. The drop may be due to students having an extremely loaded schedule, taking 7 courses per term and simply not having time to utilize the LCT resource. Another plausible explanation is that students in this class heavily favoured studying from the lecture PowerPoints which were made available and were crafted in such a way to be the “Cole’s notes” for the class. Again, it is likely this mode of studying was a time-saving mechanism for the students.

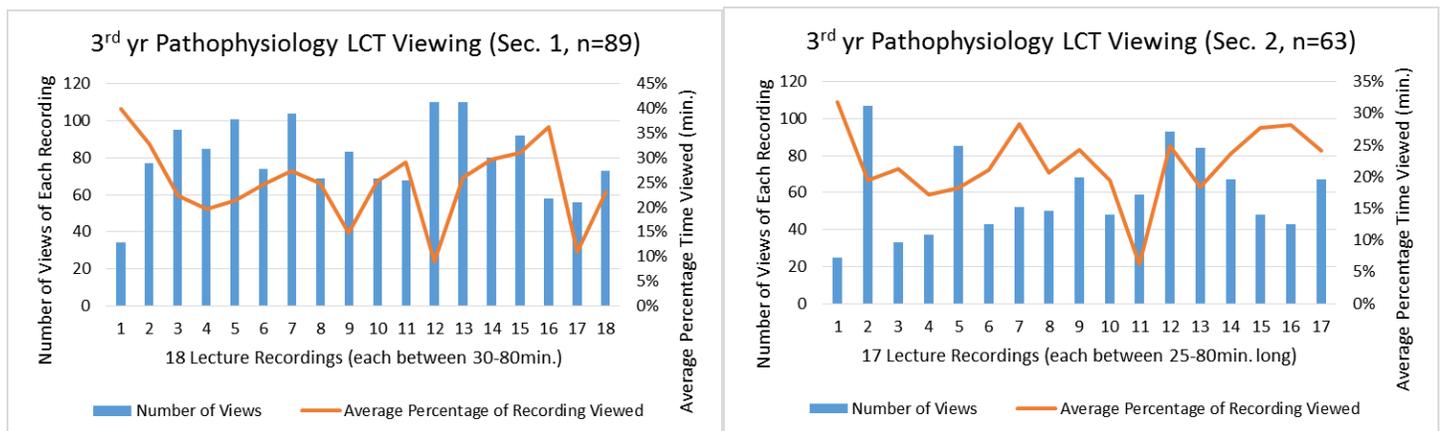


Figure 9. Third-Year Human Kinetics Student LCT Viewing Data. a) Students in Section 1 of HMKN335 recorded 80 views per recording on average and watched approximated 17min. (25%) of each recording. If 80 views is one view-per-student that means 90% of the class utilized the LCT study tool each day. b) Students in the Section 2 of HMKN335 recorded 59 views per recording on average and watched approximated 15min. (22%) of each recording. If 59 views is one view-per-student that indicates 94% of the class utilized the LCT study tool each day. It was noted that LCT usage is fairly consistent throughout each term.

It was found that with all the courses, there were two time-points in the term when LCT were accessed by the students most frequently: the first, being within a day or two of the actual class; and the second being in the days leading up to the final exam. This matched our predictions based on the literature.

It was also anticipated that LCT usage would increase as first-year Human Kinetics students progress through Term 1 and 2 and then into the second year (HMKN203). Based on the literature, we expected students to develop time management

and study skills, educational maturity and metacognition, and become more pro-active in utilizing student study resources in a strategic manner.

It is worth noting that our predictions about viewing and usage were fairly accurate with the exception that the Nursing Pathophysiology students who used the LCT tool much less than expected, especially given their poor attendance and strong academic drive. We attribute this to the heavy Nursing course load (7 courses/term). Furthermore, in a similar class to second-year Nursing Pathophysiology, in terms of content and

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delivery, the third-year Pathophysiology students actually used the LCT tool much more than expected. At the same time, attendance in this third-year course was high and remained high for the entire term, despite thoughts that attendance would drop as a result of LCT implementation. The popularity of LCT in HMKN335 may be due to the heavy content of the course, in addition, to the perceived value of all of the Q&A that were in every class that was captured on LCT. This class requires a lot of memory as well as problem-solving skills that the students are just beginning to use. The practice Q&A illustrate step by step how to answer questions about various disease and drug mechanisms

Student Satisfaction Survey Results

In order to determine whether students found LCT valuable, easy to use, convenient, and/or helpful, optional surveys were given to students at the end of term. Ninety-four first-year students consented and opted to take the survey. The results of the survey are documented in Table 1 and it is noted that overall, the students responded in a very favourable way to the implementation of LCT. The results of this table were condensed into Figure 10 to better visualize the trends found for each survey question.

	Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree	No response
Q1. I listened to some of the Recorded Lectures (RL) at least once.	46%	19%	11%	2%	10%	13%	0%
Q2. I listened to most of the Recorded Lectures at least once.	32%	6%	14%	7%	20%	20%	0%
Q3. I found the RL helpful for reviewing the material.	43%	16%	20%	6%	4%	9%	2%
Q4. I found RL helpful, because I could view it at my own pace.	45%	24%	16%	2%	3%	9%	1%
Q5. I found RL helpful, because I could view at a time that was convenient to me.	49%	21%	15%	1%	4%	7%	2%
Q6. I would rather have RL than in-class lectures.	7%	5%	12%	27%	23%	23%	2%
Q7. Having the RL was valuable, because there is a lot of content in this course.	52%	24%	16%	1%	0%	5%	1%
Q8. The RLs were a useful part of this course.	40%	27%	17%	4%	3%	7%	1%
Q9. The RLs were easy to use.	43%	34%	12%	3%	1%	5%	2%
Q10. The RLs suits my way of learning.	32%	18%	22%	7%	11%	9%	1%
Q11. I prefer learning through RLs rather than reading the textbook.	29%	16%	20%	9%	14%	11%	2%
Q12. I would rather come to class than learn through RL.	24%	27%	23%	14%	5%	4%	2%
Q13. I felt more engaged in the class material because RL Technology was used.	10%	19%	26%	28%	9%	6%	2%
Q14. RLs should be used in this course in the future.	47%	27%	18%	3%	1%	2%	2%
Q15. I think the practice questions given to us in the on-line quizzes were helpful.	45%	35%	15%	2%	0%	0%	3%
Q16. I think the textbook resources were helpful in learning & studying course topics.	27%	23%	18%	2%	1%	1%	28%
Q17. I believe the practice questions presented at the beginning of class were helpful.	39%	32%	18%	5%	2%	1%	2%
Q18. I would like to use an electronic device in class for course material.	24%	44%	20%	5%	4%	0%	2%
Q19. I found the textbook helpful in learning studying the topics.	15%	23%	30%	14%	9%	5%	4%
Q20. I kept up and reviewed the Lecture Material each week.	5%	13%	44%	16%	16%	3%	3%
Q21. I found the Poster Challenge increased student interaction & discussion in our lab.	17%	17%	27%	21%	10%	6%	2%
Q22. I think an hour of tutorial per week for this class would be helpful.	28%	26%	30%	5%	5%	4%	2%
Q23. I would have attended 1hr of tutorial/wk if it was run by an SL leader.	19%	18%	26%	20%	11%	4%	2%
Q24. I would have attended 1hr of tutorial/wk if it was run by the course instructor.	44%	29%	16%	5%	1%	3%	2%

Table 1. Anonymous survey responses of 94 first-year students at the end of term. The condensed survey results for responses in the category of Agree (Strongly Agree, Agree and Somewhat Agree) and for responses in the category of Disagree (Strongly Disagree, Disagree, and Somewhat Disagree) are shown in Figure 10.

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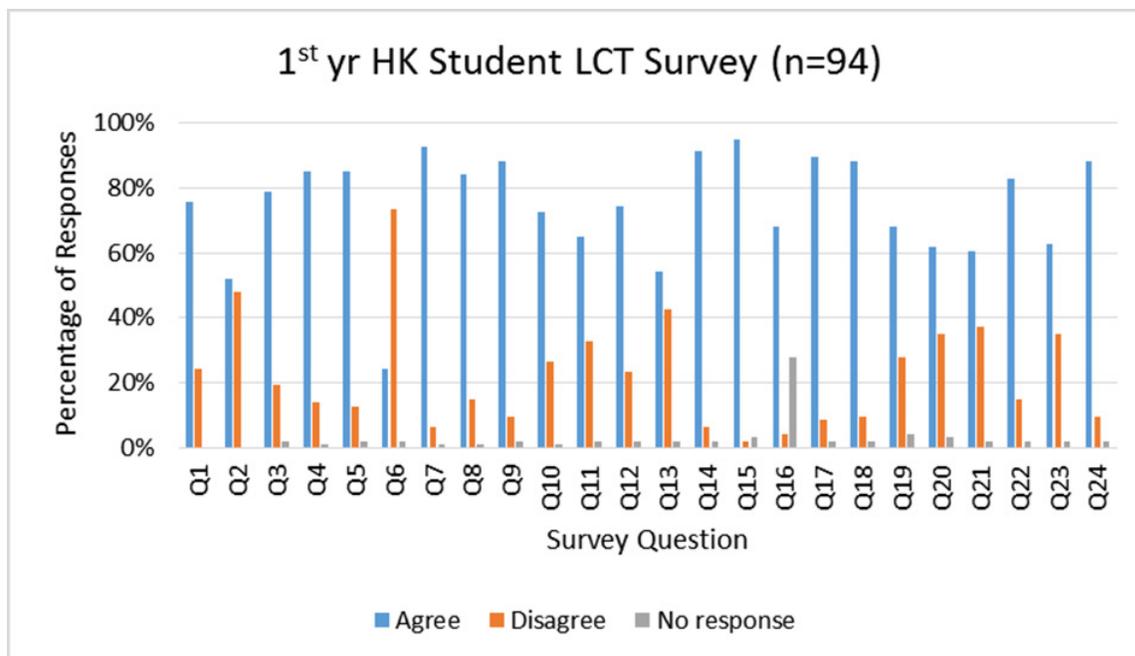


Figure 10. Condensed Results of 1st year HK LCT Student Satisfaction Survey (n=94).

After looking at the Mediasite viewing data (as laid out in Figure 6 for HMKN190/191), it appears that students were accurate and truthful when answering the first two questions of the survey regarding the number and amount of recorded lectures that they actually viewed. As anticipated, in answer to questions 3-5, and 7-10, the vast majority of students (72-88%) found that LCT was helpful for review and useful because it could be viewed at their own pace, at a convenient time, was easy to use, and suited their way of learning. Question 6 was similar to question 12, and most first-year students (74%) would rather come to class than view the recorded lectures. This was higher than we expected, as the class is very large (174 students), located in a dark lecture hall, early in the morning (8am), and wintery driving conditions prevail for much of the term. Even though attendance is not mandatory, it is thought that the daily practice questions as well as additional material taken on during class time encourages attendance. Perhaps most importantly, 91% of first-year students felt that LCT should be used in the future. Furthermore, LCT held up equally favourably to other class resources which were surveyed in questions Q19-21 and garnered between 61-95% in positive responses (Table 1). The responses to the final questions (Q22-24) were somewhat anticipated as the course is very content heavy. The students currently have two optional one-hour guided study sessions per week with a trained third-year student (SL leader). Currently, these sessions typically attract low numbers of high-achieving students. At the end of term, likely more students feel they should have participated.

For second-year Human Kinetics students, as can be seen in Table 2 and Figure 11, the survey results were very similar to those of the first-year students and even more favourable in response to some questions concerning LCT. The vast majority (81-92%) of students found that LCT was helpful for review, useful because it could be viewed at their own pace, at a convenient time, was easy to use, and suited their way of learning. For questions 1 and 2 regarding self-reporting of LCT usage, the numbers are higher than one might expect from MediaSite's tracking data (Figure 7). It is likely that students were over-estimating their use of LCT. Question 6 was similar to question 12, and most students would rather come to class than view the recorded lectures. This was higher than we expected, as attendance is not taken. It is thought that the time (11am-12noon) is conducive to attendance, as well as the extra material that is covered in class in comparison to the textbook is a drawing factor. Interestingly, just as with the first-year students, 91% of second-year students felt that LCT should be used in the future, even though likely some had not used it at all. Moreover, LCT held up equally favourably to other class resources which were also surveyed in questions 17-22 and had received in the range of 82-94% in positive responses (Table 2). The responses to the final two questions (Q21 and 22) were somewhat anticipated as students like using their electronic devices for practice Q&A and the lectures add more material than the textbook covers. Additionally many students do not buy a textbook.

	Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree	No response
Q1. I listened to some of the Recorded Lectures (RL) at least once.	51%	26%	8%	1%	8%	6%	0%
Q2. I listened to most of the RLs at least once.	35%	14%	22%	4%	16%	9%	0%
Q3. I found the RLs helpful for reviewing the material.	45%	28%	14%	4%	4%	4%	2%
Q4. I found the RLs helpful, because I could view it at my own pace.	50%	26%	14%	2%	2%	3%	3%
Q5. I found the RLs helpful, because I could view it at a time that was convenient to me.	54%	28%	10%	1%	2%	3%	1%
Q6. I would rather have RLs than in-class lectures.	8%	11%	12%	30%	23%	16%	1%
Q7. Having the RLs was valuable, because there is a lot of content in this course.	54%	31%	7%	3%	1%	2%	1%
Q8. The RLs were a useful part of this course.	44%	36%	11%	3%	1%	2%	1%
Q9. The RLs were easy to use.	43%	38%	11%	4%	1%	1%	1%
Q10. The RLs suits my way of learning.	32%	29%	20%	8%	4%	4%	2%
Q11. I prefer learning through RLs rather than reading the textbook.	38%	25%	19%	10%	5%	3%	1%
Q12. I would rather come to class than learn through RLs.	21%	30%	31%	9%	5%	2%	1%
Q13. I felt more engaged in the class material because RL Technology was used.	23%	21%	25%	20%	4%	4%	3%
Q14. RLs should be used in this course in the future.	54%	25%	14%	1%	1%	0%	5%
Q15. I think the practice questions given to us in the on-line quizzes were helpful.	45%	34%	15%	1%	4%	0%	1%
Q16. I kept up and reviewed the Lecture Material each week.	9%	16%	33%	24%	12%	5%	1%
Q17. The Baby Brain Video Assignment was useful in understanding neurogenesis.	21%	38%	26%	5%	6%	1%	2%
Q18. The Mercury Poisoning Assignment was useful in understanding toxins.	18%	34%	30%	11%	4%	1%	1%
Q19. The Stem Cell Assign. was useful in understanding stem cells, GFs, & hormones.	19%	34%	29%	9%	6%	2%	1%
Q20. The Diabetes Assign. was useful in understanding the roles of insulin, T1D, & T2D.	21%	43%	24%	7%	3%	1%	1%
Q21. I would like to use an electronic device in class for course material and Q&A.	24%	26%	25%	13%	6%	3%	4%
Q22. I found the textbook helpful in learning studying the topics.	9%	6%	26%	21%	21%	12%	5%

Table 2. Results of 2nd year HK LCT Student Satisfaction Survey (n=140). The condensed survey results for responses in the category of Agree (Strongly Agree, Agree and Somewhat Agree) and for responses in the category of Disagree (Strongly Disagree, Disagree, and Somewhat Disagree) are shown in Figure 11.

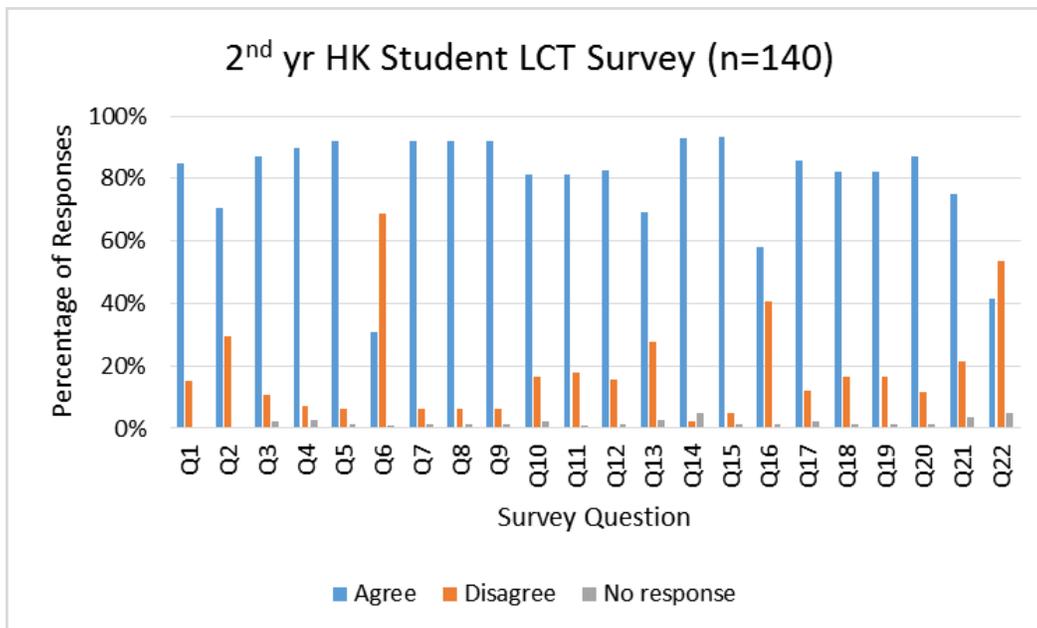


Figure 11. Condensed Results of 2nd year HK LCT Student Satisfaction Survey (n=140).

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The third-year Human Kinetics Pathophysiology class responded in a similar manner within their survey as with those of the first-year cohort for all the questions regarding LCT use and value (Table 3, Figure 12). Also similarly, the majority of students were still keen to come to class, with only 21% stating that they would rather have recorded lectures than face-to-face class. It is hypothesized that again the in-class activities, that cannot be recorded (Q&A, video clips), and possibly student-instructor engagement would be the main reasons for students wanting to come to class. In addition, the

classes were held in the early afternoon, which is a convenient time for the vast majority of our students. Furthermore, by second and third year, the Human Kinetics students have formed fairly strong bonds with their peers (despite the large class sizes) and appear to thrive in the high-energy that brings to the classroom. Attendance is not mandatory in this class, but from the instructor's perspective, the introduction of LCT did not affect attendance. Attendance remained similar to that of previous years.

	Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree	No response
Q1. I listened to some of the Recorded Lectures (RL) at least once.	45%	24%	8%	1%	2%	20%	1%
Q2. I listened to most of the RLs at least once.	35%	9%	15%	12%	7%	20%	2%
Q3. I found the RLs helpful for reviewing the material.	46%	19%	14%	4%	3%	11%	5%
Q4. I found the RLs helpful, because I could view it at my own pace.	54%	23%	10%	3%	1%	7%	4%
Q5. I found the RLs helpful, because I could view it at a time that was convenient to me.	54%	23%	9%	2%	3%	6%	5%
Q6. I would rather have Recorded Lectures rather than in-class lectures.	4%	6%	11%	17%	29%	32%	2%
Q7. Having the RLs was valuable, because there is a lot of content in this course.	54%	26%	10%	3%	1%	5%	2%
Q8. I listened to the Recorded Lectures each week.	14%	8%	11%	15%	23%	28%	3%
Q9. The Recorded Lectures were a useful part of this course.	42%	24%	17%	6%	2%	7%	3%
Q10. The Recorded Lectures were easy to use.	54%	25%	10%	1%	1%	6%	4%
Q11. The Recorded Lectures suits my way of learning.	34%	23%	22%	5%	5%	9%	4%
Q12. I prefer learning through Recorded Lectures than reading a textbook.	42%	18%	14%	9%	5%	11%	3%
Q13. I would rather come to class than learn through Recorded Lecture.	25%	26%	18%	10%	11%	8%	2%
Q14. I felt more engaged in the class material because RL Technology was used.	32%	32%	19%	11%	3%	3%	2%
Q15. Recorded Lectures should be used in this course in the future.	18%	17%	26%	19%	8%	8%	4%
Q16. I like using an electronic device in class for course material.	25%	29%	20%	12%	6%	7%	2%

Table 3. Results of third-year HK LCT Student Satisfaction Survey (n=110). The condensed survey results for responses in the category of Agree (Strongly Agree, Agree and Somewhat Agree) and for responses in the category of Disagree (Strongly Disagree, Disagree, and Somewhat Disagree) are shown in Figure 12.

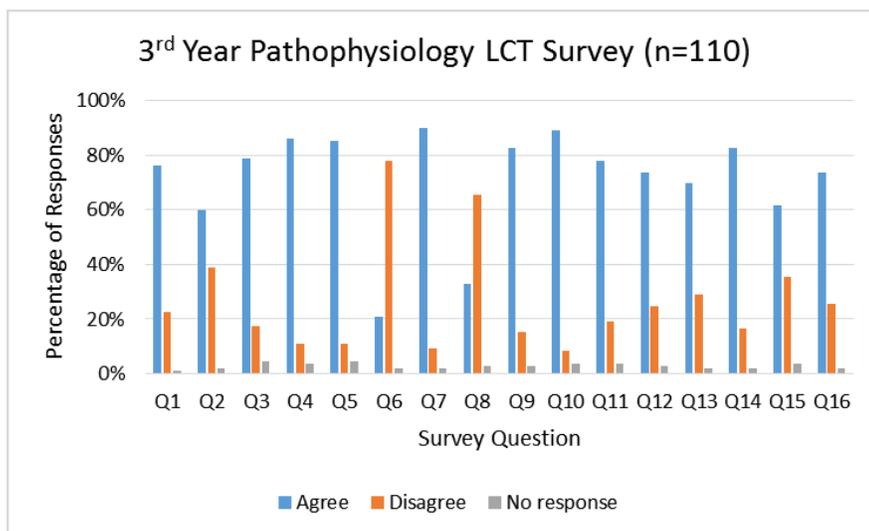


Figure 12. Condensed Results of 3rd year HK LCT Student Satisfaction Survey (n=110)

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Surprisingly, the second-year Nursing Pathophysiology class responded in a very similar manner in their survey compared to the first-, second-, and third-year Human Kinetics students (Table 4, Figure 13) despite the fact that their attendance and LCT viewing habits were strikingly lower in comparison with the Human Kinetics courses (Figure 8). The Nursing Pathophysiology course was held on Mondays from 3-6pm on a day with back to back lectures. This schedule is in place in the Nursing program to leave Tuesdays-Fridays free for their clinical course work in the downtown hospital. These students are heavily loaded with seven courses per term. As reported by both students and the instructor, it was found that by Monday at 3pm, the students were exhausted and had a hard time concentrating in class. The majority of students stopped coming to class, even though it meant missing activities and video clips in-class. These in-class activities are

low-stakes activities, as they are in the Human Kinetics classes previously discussed. The majority of Nursing students chose to learn through posted PowerPoints of the lectures material instead. Interestingly, despite the low attendance and low LCT viewings, 82-94% of respondents stated that they found the lecture recordings helpful for reviewing, valuable due to the length of the Monday classes, and helpful for viewing at one's own pace at a time that was convenient. In the open answer comment box within the survey, many students did state, that although they had not personally used the LCT, they knew classmates who were using it and benefitting greatly from them. Again, LCT was viewed favourably as was the in-class and posted student resources as cited in answers to questions 16-23. It is hypothesized that although most of the Nursing students did not use LCT, they appreciated having a "back-up" just in case the lecture PowerPoint notes needed clarifying.

	Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree	No response
Q1. I listened to some of the Recorded Lectures (RL) at least once.	39%	33%	6%	3%	7%	12%	0%
Q2. I listened to most of the RLs at least once.	16%	24%	21%	6%	16%	16%	0%
Q3. I found the RLs helpful for reviewing the material.	28%	42%	12%	7%	1%	7%	0%
Q4. I found the RLs helpful, because I could view it at my own pace.	36%	40%	15%	0%	0%	6%	0%
Q5. I found the RLs helpful, because I could view it at a time that was convenient to me.	46%	31%	16%	0%	0%	4%	0%
Q6. Having the RL was valuable, because I found the three hour class too long.	36%	34%	13%	6%	4%	4%	0%
Q7. I found the 3 hour class is too long.	54%	27%	7%	3%	3%	4%	0%
Q8. I think this class would be better if it was (2x 80min) rather than (1x180min).	67%	24%	3%	0%	3%	3%	0%
Q9. The Recorded Lectures were a useful part of this course.	42%	36%	13%	1%	1%	4%	0%
Q10. The Recorded Lectures were easy to use.	40%	34%	12%	6%	1%	4%	0%
Q11. The Recorded Lectures suits my way of learning.	28%	30%	18%	4%	6%	9%	0%
Q12. I prefer learning through Recorded Lectures than reading a textbook.	24%	25%	18%	13%	9%	9%	0%
Q13. I attended all 3 hours of each class, this term.	7%	10%	12%	9%	31%	30%	0%
Q14. I would rather come to class than learn through Recorded Lecture.	16%	30%	28%	13%	9%	1%	0%
Q15. I felt more engaged in the class material because RL Technology was used.	6%	25%	33%	21%	7%	7%	0%
Q16. I like using an electronic device in class for course material.	24%	42%	21%	4%	4%	4%	0%
Q17. RLs made me feel comfortable learning and reviewing new material.	24%	34%	19%	12%	3%	7%	0%
Q18. Recorded Lectures should be used in this course in the future.	43%	33%	18%	3%	0%	3%	0%
Q19. I found the practice questions in this course helpful	43%	33%	19%	1%	1%	1%	0%
Q20. I found it was helpful when provided with answers to the practice questions.	67%	27%	4%	0%	0%	1%	0%
Q21. The endocrine videos shown in class and posted to Connect were helpful.	31%	42%	24%	1%	0%	1%	0%
Q22. The digestive system videos shown in class and posted to Connect were helpful.	24%	36%	34%	1%	1%	3%	0%
Q23. I kept up with Lecture Material each week.	18%	28%	18%	12%	4%	9%	0%

Table 4. Results of 2nd year Nursing LCT Student Satisfaction Survey (n=67). The condensed survey results for responses in the category of Agree (Strongly Agree, Agree and Somewhat Agree) and for responses in the category of Disagree (Strongly Disagree, Disagree, and Somewhat Disagree) are shown in Figure 13.

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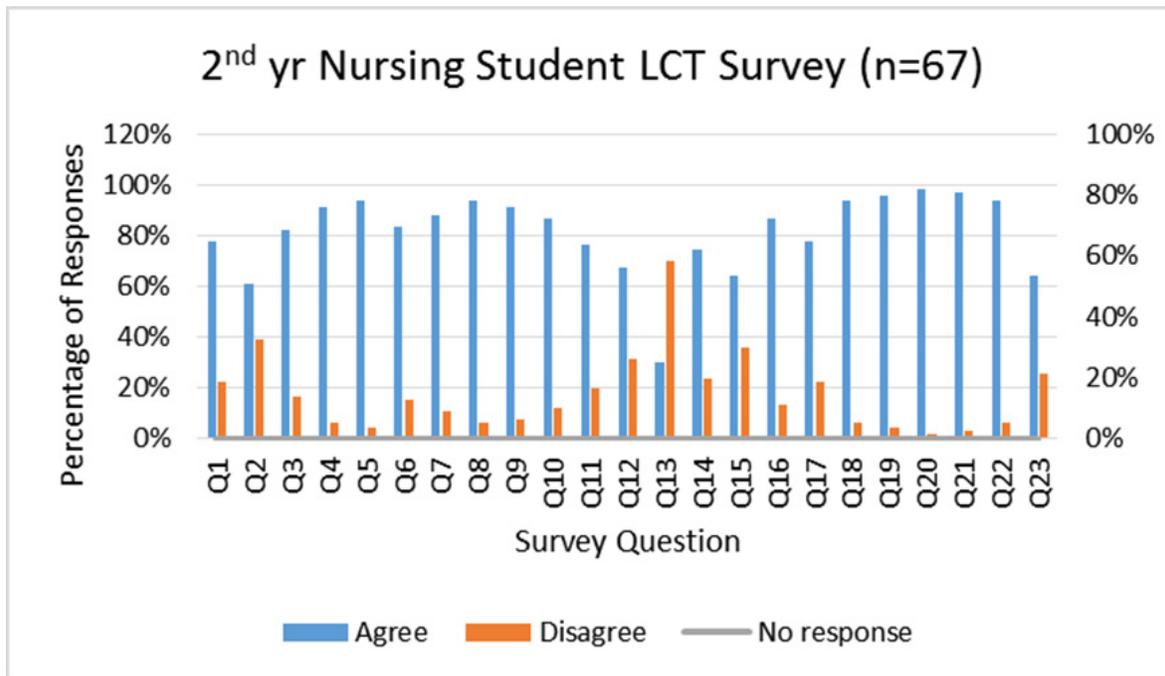


Figure 13. Condensed Results of 2nd year Nursing LCT Student Satisfaction Survey (n=67).

Finally, as one might expect, with each of the four classes and four surveys, Pearson correlational analysis revealed that there were strong correlations between the positive responses on related questions. Strong correlations and clusters of positive responses exist in the HMKN191 survey (Q1-14 and Q21). In addition, three clusters exist in the HMKN203 survey: i) Q1-11, 13-14; ii) Q12 and 15; and iii) Q17-20. Furthermore, three clusters exist in the HINT231 survey: i) Q1-6, 9-12, 15, 17, and 18; ii) Q7 and 8; and iii) Q13-14. Lastly, three clusters exist in the HMKN335 survey responses: i) Q1-12, 15-18; ii) Q13-14, and iii) Q19-21. This is not surprising as the questions were related to each other, so students would be more likely to answer them in the same ways.

Student Survey Responses in Relation to Exam Marks and Final Grades

We were interested to know whether high-achieving or low-achieving students benefited most from LCT. Pearson correlational analysis revealed weak correlations between low exam scores and positive responses to survey questions

regarding LCT as well as other student resources. However this was only found to be the case in the first-year course, specifically with the following questions: Q1-3, Q6-11, and Q13. These results indicate that LCT in first-year was the most popular with low-scoring students, either because they used it the most, and/or because they perceived LCT as having a lot of value.

The Effects of LCT on Attendance

Daily attendance was only actively monitored in the first-year courses, though the instructor of all of these courses did not feel that attendance changed at all from previous years with the implementation of LCT. This is with the exception of the nursing course (HINT231), in which case it was the first time this course was offered so no previous data exists. Attendance data and number of recorded views per day for first-year Anatomy and Physiology is shown in Figure 14. Attendance was consistent with historical numbers and did not drop as a result of the implementation of LCT.

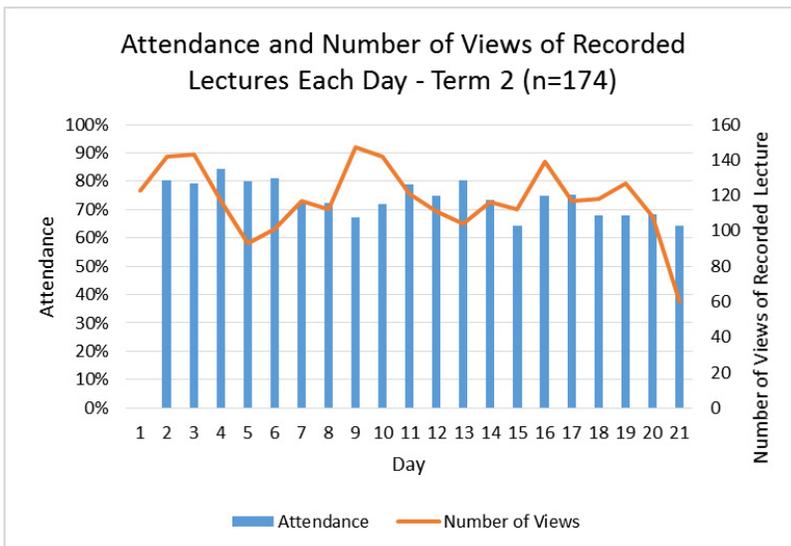
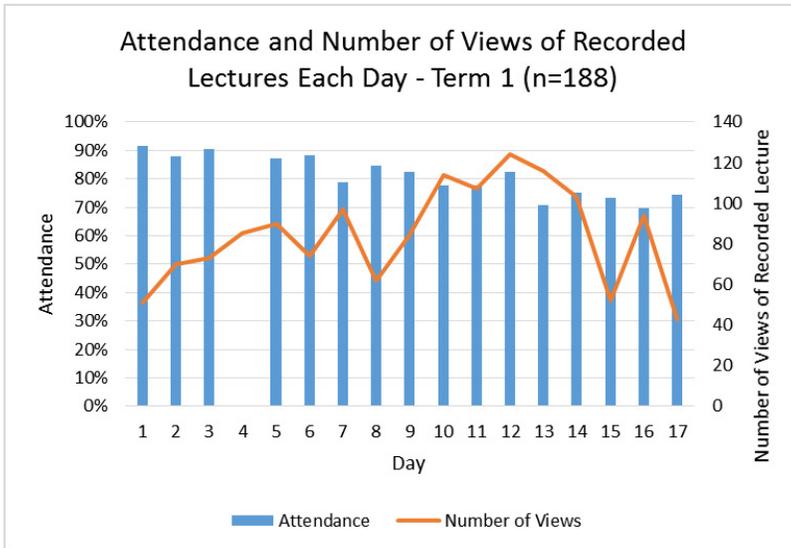


Figure 14. Attendance and LCT viewing data for 1st year HK. a) Day 4 was not recorded.

As might be expected, Pearson correlational analysis revealed weak correlations between low attendance and positive survey responses to the LCT questions in the first-year course. This means that students who had lower attendance valued LCT to a greater degree. A further analysis was done with the first-year data to determine whether there is a relationship between attendance and course grades. Weak Pearson correlations exist between high attendance and midterm results (0.217, significant at the 0.05 level, 2-tailed) and moderately strong Pearson Correlations were found between high attendance and final grades (0.474, significant at the 0.01 level, 2-tailed).

Gender difference in LCT survey and grades and attendance.
 In all of these courses, female students outnumber male students. It was noted in the literature that female students were more likely than male students to view videos (Wiese and Newton 2013). In order to determine whether a similar phenomenon occurred in the first-year course and whether there were gender differences in attendance and grades, attendance and exam data were collected and compared in

an anonymous manner by students that consented to the study. It was found that male students (n=38) were less likely to come to class than female students (n=101). For example, in HMKN190, the average attendance rate for males was 69.25%. Males on average attended 69.25% of the total number of classes in the term. Females on average attended 82.15% of the total number of classes in the term. This 13% difference widened to 16% in the second term in HMKN191.

Interestingly, according to Q1 and Q2 responses in the survey, first-year males were less likely to view LCT, and on average answered disagree or somewhat disagree to those viewing questions. On the other hand, females on average, were more likely to answer positively to those two questions. In terms of the survey, this was the end of the gender differences, as the rest of the survey was answered similarly between male and females. Surprisingly, there were significant differences found between many of the exam grades, as shown in Table 5. Though it is speculated that the strong correlation between attendance and grades likely accounts for this phenomenon.

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	Male				Female			
	Mean	N	Std. Deviation	Std. Error	Mean	N	Std. Deviation	Std. Error
HMKN190 Attendance	69.25%	38	28.84%	4.68%	82.15%	100	17.34	1.73%
HMKN190 Midterm1	75.17%	39	13.59%	2.18%	77.00%	101	12.41%	1.24%
HMKN190 LabExam1	76.53%	39	18.09%	2.90%	88.64%	101	10.12%	1.01%
HMKN190 Final Exam	67.52%	38	15.07%	2.44%	70.92%	101	11.75%	1.17%
HMKN190 Final Grade	74.95%	39	13.99%	2.24%	81.17%	101	9.14%	0.91%
HMKN191								
HMKN191 Attendance	62.89%	29	31.88%	5.92%	78.85%	95	24.35%	2.50%
HMKN191 Midterm1	62.89%	29	31.88%	5.92%	78.85%	95	24.35%	2.50%
HMKN191 LabExam1	67.67%	30	15.99%	2.92%	73.52%	125	11.89%	1.06%
HMKN191 Final Exam	72.10%	30	12.88%	2.35%	73.99%	95	11.59%	1.19%
HMKN191 Final Grade	64.88%	30	12.85%	2.08%	78.14%	96	10.11%	1.03%

Table 5. Gender differences in attendances and grades.

The other courses (HMKN203, HMKN335, and HINT231) were analyzed in a similar manner, to determine whether gender differences existed in self-reported LCT viewing, attendance, survey responses, and grades. No differences were found.

Conclusions

Overall, the implementation of LCT in five different courses met our hypothesis that students would respond favourably and appreciate the additional study tool. LCT will be something that is continued to be used in the future. The students found the LCT helpful for clarifying their notes after class, for reviewing prior to exams, and for catching up on days that they were absent from class. It saved some students time in that they could access the instructor's help via LCT at times that was convenient to them, and at a pace that suited them. Recordings could be sped up or slowed down and it was evident that students picked and chose which areas of the recording to view (averaging at approximately 25% length of the total recording). In this way, students could take charge of their own learning and possibly develop educational maturity and metacognitive skills. Some students mentioned juggling work or other courses in the survey comment section and it meant they did not have to worry about arranging to attend office hours or tutorials. It helped the varsity athletes who had to be away for games and tournaments. It also helped students with disabilities as well as the tutors, TAs, and scribes for the course.

For all of the courses, the number of views was higher than expected, with the exception of the Pathophysiology for Nursing course, which had fewer views than expected. The nursing class logged the lowest number of views per day (~37% of the class) and the third-year Human Kinetics students logged the highest number of views per day (~94% of the class). As the nursing course did have the most content, it was anticipated that the usage of LCT in this class would be the highest. In addition, the low attendance in this

course, also led one to believe that LCT would be used a lot, however this was not the case, likely due to the heavy course load in this program that placed high demands on time. Despite this, nursing students responded similarly in the student satisfaction survey as students in the other courses, responding very favourably to the implementation of LCT and valuing it just as much as other course resources (practice questions, video clips, demos, and in-class activities).

In addition, we were interested to note that in the first-year anatomy and physiology course in which attendance was monitored, there were: i) weak Pearson correlations observed between lower grades and positive perceived value of LCT as per survey responses; and ii) a moderate to strong correlation between attendance and course grades. Finally, we were surprised to note that in this first-year course (and only in this course) there were significant differences between the genders in: i) a self-reported use of LCT; ii) attendance; and iii) exam and final grades for the course.

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