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Asynchronous E-learning after Synchronous E-learning in the Pathology Course. When is the proper time for this transition?

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Abstract:

BACKGROUND: Recordings of live streaming e-lessons of pathology at medical school of National and Kapodistrian University of Athens, Greece are uploaded to the e-class portfolio of each student enrolled in the course. We measured the number of views each video received and noticed that this number exceeded the number of enrolled students. Our main aim was to investigate the correlation between the upload of an educational video and the views it got so as to determine when the proper time is for professors to e-share or upload an educational video for the students.

MATERIALS AND METHODS: We measured the number of views of the recorded e-lessons when all videos were uploaded, with a frequency of 15 days. We used analysis of variances statistical analysis to find the significance of the amount of time each video had been uploaded on the virtual platform of the course. We also applied *t*-tests to assess the significance of alteration of the number of views related to the amount of time until the examinations.

RESULTS: Time was a statistically significant factor in the impact of an educational video. The two-factor analysis without interaction measured $P \approx 0.001$, proving the strong correlation between time and the increase of views. As the examination date was approaching, there was a statistically significant increase in the number of views of the videotaped e-lessons. Almost 50% of the views of each of the videos took place in the two-week examination period of the course.

CONCLUSIONS: The educational videos that contained the core learning concepts of the pathology course should be uploaded first. The complex learning points of the pathology course must be available at the beginning of the semester. Additionally, recordings of videos covering the complex learning points of the course should be uploaded as an additional tool of asynchronous e-learning for the students who choose to watch their former e-lessons to prepare for the examinations.

Keywords:

E-learning medical education, e-lessons, medical educational videos, medical research, pathology course

Introduction

Videos, as tools of asynchronous e-learning in medical education, are not new entries, nor have they been studied a little. Video collections,^[1] video feedback,^[2-4] video effectiveness,^[5,6] video groups^[2] and multiple video comparisons^[7-9] are some examples

of the utilisation of video technology in e-learning. Videotaped e-lessons, however, introduce a new module of asynchronous e-learning, totally organised in terms of synchronous e-learning, from the beginning until the end of the semester, and have replaced educational procedures in classrooms due to the COVID-19 pandemic. This study focuses

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on a pathology course that, for the first time, adopted the practice of videotaping the 3-h weekly live-streaming e-lessons and later made them available for all enrolled students of the course to watch. Today's students are considered 'digital natives'^[10,11] as they not only came into contact with information and communication technology through education^[12] but grew up in parallel with the widespread use of the internet and vast technological advances and innovations, during the decade of 2000.^[13] Today's medical trainees who are considered among the first generation of digital natives^[11] are also considered more adept at accessing video-based sources.^[10] Video use meets the needs of the current digital generation of students,^[14] as they are considered skilled and capable of following both synchronous and asynchronous e-learning courses.^[15]

Our study includes the educational context of the course of pathology at the medical school of the National and Kapodistrian University of Athens, the subjects that were taught and the procedure through which e-lessons were organised, videotaped and shared with the students. Our main focus was on the number of views of videotaped e-lessons. We measured the number of views of each video and noticed that the number was much bigger than the number of enrolled students. Therefore our research focused on this practice of the faculty and wanted to find out if the number of views of the e-lessons' videos was affected by the amount of time the videos have been uploaded and if there is a significant alteration in the number of views when there is an upcoming examination.

Key Messages: The earlier a video was available for students to watch, the higher the number of views it got. This could suggest that the lessons containing the most key points should be conducted first. Interestingly, as the examination date was approaching, there was a significant increase in the number of views indicating that examinations are the ones that trigger the engagement with the subject and not the subject and the way of teaching it per se.

Materials and Methods

Study design and setting

The second part of the systemic pathology course is delivered in the fifth semester of the curriculum of our medical school, which is a pre-graduate program of 12 semesters in total. It includes the systemic pathology subjects shown in Table 1. Lessons normally take place at lecture theatres to accommodate the high number of enrolled students.

Due to the COVID-19 pandemic, all universities in the country had to offer all their lessons through synchronous and asynchronous distant methods.^[16] The pathology

course adopted new methods for live-streaming lessons because the asynchronous e-learning method had already been established for 8 years on the e-class platform of the university. The asynchronous e-learning modules already offered for the pathology course were: Massive Open Online Courses, the interactive pathology platform HIPON,^[17,18] videotaped lectures from lecture theatres and other pathology legible e-resources. Students of our study, from the middle of their fourth semester, had had no choice but to follow e-learning methods due to the pandemic. When they enrolled on the pathology II course in their fifth semester, they had previously been taught pathology I through live-streaming lessons during their fourth semester, although this did not offer the videotaping practice.

Study participants and sampling

The number of students registered in the pathology course was 257 of whom 196 took the examinations at the end of the semester, with every student achieving a passing grade. The 3-h synchronous e-lessons took place at an appointed time on a weekly basis for 13 weeks and were delivered via the platform Skype for Business. Cognitive load theory^[19] and Mayer's cognitive theory of multimedia^[20] were applied in every e-lesson, as each one of them contained slide-text-photo presentations and microscopy histology images in high resolution. The professor was constantly present in a separate column during every e-lesson. When a live-streaming pathology II lesson came to an end, the video of this lesson was made available on each student's e-portfolio for them to watch again. These asynchronous videos offered medical students the flexibility to review material at their own pace in order to address their individual learning needs.^[5] Moreover, videotaping e-lessons allowed students to make observations and reflections in an unhurried environment.^[2,21] The existing literature supports that video, specifically, can be a highly effective educational tool.^[22-24]

Students involved in our research had been informed about the nature of it and consented to the recording of their e-lessons and the following upload. Videos were available from the time they were uploaded until at least the end of the semester. They could be viewed multiple times by the students and the number of the views was counted by the platform.

Students were securely anonymised in order to ensure privacy and data protection. Attendees' cameras and microphones were disabled at all times during the e-lessons, but the chat was visible and enabled. The interactive procedure took place in the chat column, where students wrote questions or answers to the professor's oral questions, using either their own names

Table 1: Numeric data of the videotaped e-lessons' views during the semester in the pathology course

Number of the video and title of the lesson	Number of views during the 2-week examination period	Number of views 15 days before the examinations	Number of views 1 month before the examinations	Number of views 1.5 months before the examinations	Number of views 2 months before the examinations
Video 1: Urinary system anatomy and histopathology	329	253	232	215	193
Video 2: Non-neoplastic kidney diseases and urinary bladder diseases	322	193	168	140	121
Video 3: Male genital system diseases	294	175	154	133	106
Video 4: Alimentary tract diseases. Oral cavity and salivary glands pathology	348	194	160	126	101
Video 5: Liver and pancreas diseases	261	130	114	86	65
Video 6: Endocrine diseases	216	110	99	76	39
Video 7: Skin diseases – Systemic pathology repetition	293	149	128	69	0

or pseudonyms.

Data collection tool and technique

The data for this study were collected from the 3-h online lessons that were recorded and uploaded as video files to the e-portfolio of each enrolled student on the pathology course, with the use of an accessing password. We measured the number of views of the recorded e-lessons during the last two months before the examinations, when all the videos had been uploaded, with a frequency of 15 days. Cumulatively, the number of views totalled more than $N = 2000$. This was greater than the number of enrolled students, which was $N = 257$.

Two research questions arose from this practice of the faculty and its great acceptance by the students: How significant is the time of posting a video for the number of its views? How significant is the alteration in the number of views relative to the date of examinations? We applied analysis of variances (ANOVA) statistical analysis for the significance of the time at which each video was uploaded to the platform of the course. We also applied *t*-tests statistics to investigate if the views of the recorded e-lessons were increasing as the examination date was approaching [Figure 1].

We applied ANOVA statistical analysis for the significance of the time at which each video was uploaded to the platform of the course. We applied ANOVA to identify the statistically significant differences between columns and rows,^[25] to wit between e-lessons video views and a specific time period before the examinations. We did a two-factor analysis without interaction.

Results

The total number of views of almost all the videos is greater than the number of the enrolled students ($N = 257$). Video 1 had 58% of its total views two months before the examinations. It was the first e-lesson of the semester and was uploaded in September. On the other hand, Video 7

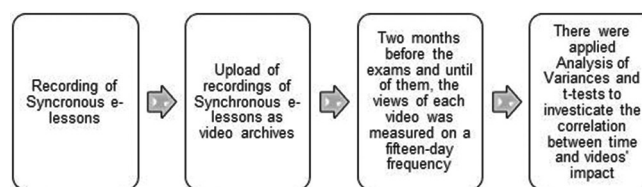


Figure 1: Collection and analysis of the data

had no views two months before the examinations, as it was taught and uploaded 59 days before them. Videos 2 and 3 were uploaded in October and had reached 37.5% and 36% of their total views, respectively, by the two months before the examinations. Finally, Videos 5 and 6 were uploaded in November and had reached 24 and 18% of their total views, respectively, two months before the examinations [Table 1].

It is clear from both Table 1 and Figure 2 that videos that were uploaded for a longer period of time received more repeat views. Additionally, we see that there is an alteration in the number of views approaching the examination date. The statistical analysis that follows will examine the significance of the time an educational video has been uploaded, and whether the change in the number of views is significantly approaching the examination date.

Statistical analysis results

Since the *P* value is 0.00179% which is $<5\%$ ($\alpha = 5\%$), it is observed, according to the ANOVA, that there is a statistically significant difference in the number of views during the time period of two months before the examinations. The date on which videos were uploaded and became available for students to watch seems to be a major factor in the number of views it receives [Table 2].

Concerning our second research question, our data were analysed using independent sample *t*-tests and a null hypothesis that there is no significant change in the number of video views during the examination period.

Table 2: Analysis of variances

Origin of variances	SS	Degrees of freedom	MS	F	P	F-test
Videos	2419.085714	6	403.1809524	0.343194619	0.906888	2.508189
Distance to the examinations	56001.88571	4	14000.47143	11.91744408	1.79E-05	2.776289
Error	28194.91429	24	1174.788095			
Total	86615.88571	34				

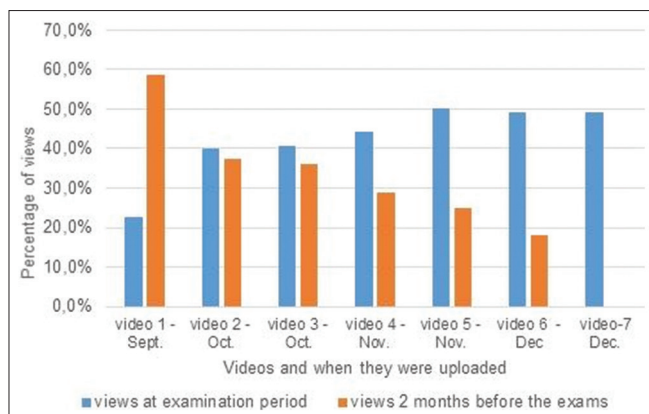


Figure 2: Percentage of pathology e-lessons' video views related to the total views

P value <5% was a significant level to suggest evidence against the null hypothesis. Our results listed are:

- Between the examination period and 15 days before the examinations, we found $P (T \leq t)$ two-tail = 0.0000359%.
- Between the examination period and 1 month before the examinations, we found $P (T \leq t)$ two-tail = 0.000242%.
- Between the examination period and 1.5 months before the examinations, we found $P (T \leq t)$ two-tail = 0.00214%.

The above *P* values were < 0.05%, which shows that there is a statistically significant alteration in the number of video views when approaching the examination date. Students seem to choose to watch the videotaped lessons as close to the days of the examinations as they can. It is the first time that this asynchronous e-learning tool was offered to students and it seems it was a highly adopted tool.

Discussion

The results we got from the statistical analysis led us to take into consideration that if there are educational videos containing the complex learning points, they should be uploaded first. The influence of timing on an educational video has been emphasised^{2 p. 17} and our research results align with the existing literature. Time of upload is a statistically significant factor for an educational video. The earlier a video is available for students to watch, the higher the number of repeat views it gets. This, up to an extent, could suggest that the lessons containing the most key points should be

conducted at the beginning of the semester. The content of the course and the order of the subjects and lessons should be carefully selected, especially as students will have the opportunity to rewatch their e-lesson videos. In the semester's material distribution strategy, the most complex points should be preceded, as this will give students more time to deal with them so that they will consolidate them easier. When instructors carefully set learning objectives in educational videos, they promote learning outcomes for their students.^[26] The video contents that focus on and illustrate key instructional points reduce a student's cognitive load.^[27,28]

But what if all the educational videos were uploaded on the same day? This could only happen after the end of the last e-lesson, which would be at the end of the semester. Realistically, students would not have enough time to watch all of them, as the duration of the videos would be too long for the short period between the last e-lesson and the examination. In addition, educational videos are not the only asynchronous e-learning module offered to students.

It is not surprising that during the examination period, students choose to watch their former e-lessons. It has been mentioned that videos, as educational elements, can improve the video watchers' retention^[29] and that they can be replayed in the preparation for examinations.^[30] Almost 50% of the views of each of the videos took place in the two-week examination period of the course. All students of our study that took the examination succeeded. However, this research focused on videos' popularity by measuring and analysing the number of views and did not study the effectiveness of the practice of videotaping the e-lessons in relation to achievement. This approach requires questionnaires to assess both the synchronous and the asynchronous e-learning methods of pathology.

Students tend to revise the course's material solely for the purpose of achieving in the examination of the lesson. The threat of examinations as a motivation for learning is of dubious value, as it often limits the joy of discovering knowledge through a two-way, creative learner-trainer relationship. The education system which is completely focused on the success in the examinations prefers the 'useful' over the 'essential', as the trainee's main goal is the success in the examinations and not the acquisition of substantial, experiential knowledge; in this way, he/

she is trapped in a strategy of success in the examinations without being primarily interested in his/her personal communication with the professor. Furthermore, behind the exclusive focus on the examination process, the indifference of professors to communicate effectively with their students is often hidden.

Developing a strategy for examination success does not necessarily coincide with gaining the essential knowledge that is what will be transformed into future professional experience. Substantial knowledge is better acquired when the educational process is based on interactivity either via the physical presence of the teacher or via synchronous distance learning, but not merely through the attendance of asynchronous videotaped lessons. Regarding the latter, videotaped lessons cannot be interactive; however, other forms of asynchronous e-learning can effectively incorporate interactive modules.

Our suggestion for the asynchronous e-learning module of the faculty platform is to adopt new technology with an emphasis on the analysis of the videos' usage by each student. At the moment, our technology does not allow us to determine the most viewed parts of each e-lesson, nor if students replay or pause in specific parts. This knowledge would be vital for the professors and could be used to increase the quality of teaching. It is also important to see how long it really takes a student to watch a video from beginning to end. This could lead to changes to the duration of the videos to help avoid cognitive overloading and, eventually, the reduction of file sizes, which would increase the platform's effectiveness. We hope that in the future new tools will provide a deeper analysis of educational videos.

Moreover, this study did not aim to investigate the practice of videotaping the e-lessons in relation to achievement. Besides, this approach would require questionnaires to assess both the synchronous and the asynchronous e-learning methods of pathology.

Limitations and recommendation

This study was targeted to a specific medical class and, thus, our findings might not directly translate to other classes. Nevertheless, we strongly believe that our results are still applicable to other medical classes in the field of e-learning methods that share similar characteristics.

Conclusions

- A new asynchronous e-learning tool i.e., videotaped live streaming e-lessons of Pathology, has been used and evaluated.
- The earlier an asynchronous pathology live-streaming

video is shared, the greatest number of repeat views it gets, as expected.

- The most difficult e-lessons with complex learning points should be videotaped and uploaded at the beginning of the semester.
- Students tend to watch a greater number of e-lessons when the examination period approaches.

Ethical consideration

This study is part of a research project related to e-learning in the pathology course and the authors maintained all the protocols before performing all the procedures engaged in this study. Its research protocol is in accordance with the ethical standards and has obtained the approval of the Ethics Committee of the anonymous part, code number: 429/210121. It has followed the guidelines of the Declaration of Helsinki and its later amendments or comparable ethical standards.

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Conflicts of interest

There are no conflicts of interest.

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