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ON THE CONTRIBUTION OF LEARNING ANALYTICS TO THE QUALITY OF HYBRID COURSE DELIVERY

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ABSTRACT

This paper discusses the use of the learning analytics that are commonly available to teachers in general, but particularly to the academic staff at the University of South-Eastern Norway (USN). The importance of the information provided by the tools that are normally used for teaching and learning activities is discussed, and supporting data are presented for a specific course: CS4110 Hardware/Software Codesign of Embedded Systems.

INTRODUCTION

Hybrid course delivery may be generally defined as a combination of on-campus and online teaching and learning activities. It became particularly common to cope with confinement restrictions imposed by the Covid-19 pandemic, but it is not really new, and has been commonly used over the years to support specific forms of blended-learning course delivery (Ferreira, 2014). The author's experience combines a flipped-classroom model based on a video library (enabling the students to watch the lectures prior to attending each session) and allows the teacher and the students to participate regardless of their location. The setup allowing simultaneous on-line and on-campus course delivery goes far beyond the contingency plans demanded by the Covid-19 pandemic. In fact it paves the way for a vision of the future where the act of teaching uses the classroom as the central stage, but includes participants anywhere. The students, and indeed the teacher as well, can participate from any location of their choice. This is by no means a proposal to replace on-campus by online activities as our main course delivery method, but rather to extend the teaching and learning activities beyond the classroom walls, providing benefits for all parts, including teachers, students, institutions and society. The flexibility provided by this model facilitates the participation of working students or students that for any other practical or health reasons are not able to attend on-campus, but its main virtue is to enable the integration of on-campus and distance education models, which will become increasingly important in the near future.

LEARNING ANALYTICS AVAILABLE AT USN

In preparation for a future where the activity of learners will increasingly move towards online, it is important to realize that the footprint left by the students is far richer in the case of their digital activities, rather than those that are carried out solely in the classroom. These two modes of participation will increasingly coexist in the future, and it is therefore important to realize how this digital footprint can be used to improve the quality of teaching and learning. This is an important form of "learning intelligence", commonly known as "learning analytics", which may be defined as "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" (Mangaroska & Giannakos, 2019).

All classrooms in USN's Krona building in the Kongsberg campus are equipped to enable the participation of students located elsewhere. This equipment comprises the devices needed for video and audio streaming, and a smartboard that plays a vital role to ensure similar quality of learning for students located outside. Whenever video streaming is not available by default, a simple webcam can be connected to one of the USN ports of the classroom desktop computer.

Apart from the equipment available in the classrooms, USN teachers have access to standard platforms commonly used in this context, namely Canvas (e-learning) and Zoom (video conferencing). Video lectures can be created using PowerPoint (exporting the presentation into mp4 format) or other tools, and those videos can be hosted on institutional platforms, such as Mediasite, or even public platforms such as YouTube. Apart from the digital learning analytics provided by this portfolio of tools, USN carries out standard pedagogical surveys to assess the quality of the teaching and learning experience in every course. This paper focus on the digital footprint left by the students that attended the CS4110 Hardware/Software Codesign course in the 2021/22 edition of USN's Computer Science master program (MACS/MACSI).

LEARNING ANALYTICS FOR CS4110

The digital footprint of students' activities is not restricted to those carried out off-campus. Indeed, in the case of CS4110, most of that information corresponds to Canvas statistics and to YouTube analytics. The Zoom reports, which are mostly related to students attending online, can also relate to students attending in the classroom (when they engage in breakout rooms with their group mates). CS4110 follows the standard course delivery model of MACS/MACSI, where all courses are 10 ECTS and are delivered one-course-at-a-time over a

period of 6 weeks. The first week is the "reading week", where the students are mostly involved in preparatory work. The second week comprises intensive lectures, the three following weeks correspond to a project assignment accounting for 50% of the final grade, and the last week is when the final written exam takes place (accounting for the remaining 50% of the grade). The course plan created for the first two weeks in the 2021/22 edition was made available online beforehand (CS4110, 2021) and details the daily learning tasks proposed to the students.

The CS4110 course was accompanied by a set of 60 learning units uploaded to Canvas, comprising video lectures, hands-on lab scripts, tutorials, discussions, etc. The course was still running at the time of writing (in the second week of the project assignment), but the statistics provided by Canvas were already fully representative since the class activity in the e-learning platform concentrates on the first two weeks of the course.

Table 1 Canvas Page Views for CS4110 (Reading Week)

Type	<08.11	08.11	09.11	10.11	11.11	12.11	13.11	14.11
INT	1	9	15	26	33	35	35	35
INT	7	18	46	79	84	84	84	116
FT	1	78	95	148	203	268	316	336
INT	52	72	74	74	141	141	141	285
INT	50	71	132	169	193	203	203	215
IM	104	150	218	267	343	354	354	398
INT	0	4	8	10	14	16	16	16
INT	0	58	92	92	92	95	95	95
FT	107	164	172	172	172	172	228	263
INT	24	81	105	111	131	135	164	168
INT	8	13	22	24	24	24	24	26
INT	18	27	40	44	50	50	50	50
INT	581	636	771	849	960	978	1156	1258
IM	56	135	215	307	325	326	335	336
INT	0	10	10	12	16	18	18	18
FT	49	54	200	212	221	224	227	238
FT	2	17	25	50	60	64	64	64
FT	0	45	70	70	70	70	70	70
INT	37	86	180	234	259	263	267	290
IM	145	167	183	183	183	183	191	211
IM	134	141	155	197	202	202	204	208
INT	94	167	232	280	301	363	363	363
FT	35	80	131	160	184	184	200	237
IM	0	15	57	62	73	79	79	79
INT	144	181	284	409	416	416	416	416
INT	79	214	243	243	296	308	324	324
FT	108	110	110	157	160	205	205	205
IM	57	86	104	110	117	166	166	166
INT	108	124	138	216	219	268	302	305
INT	35	100	113	170	174	177	240	269
average	68	104	141	171	191	202	218	235

Canvas statistics

Tables 1 and 2 show the Canvas Page Views count for the reading week (Monday 08.11 to Friday 12.11) and the intensive lectures' week (Monday 15.11 to Friday 19.11). The 2021/22 cohort comprised 17 international students, 7 full-time students, and 6 industry-master students (who work part-time in a company). The leftmost column identifies the type of student (INT: International; FT: Full-time. IM: Industry-Master), and the last line shows how the number of average Page Views evolved over the two weeks.

Canvas defines Page Views as “requests to the server”, and warns that “page view data should be used as a good approximation to student activity and not [as] an absolute metric” (Canvas 2021). It is particularly relevant to note that Canvas emphasizes the importance of seeing Page Views as an approximate indication of student activity, and we can understand why by looking at a specific example.

Table 2 Canvas Page Views for CS4110 (Int. Lectures’ Week)

Type	15.11	16.11	17.11	18.11	19.11	20.11	21.11
INT	67	94	129	147	147	147	149
INT	136	140	145	147	164	164	164
FT	357	366	376	381	383	383	383
INT	295	305	341	341	348	374	374
INT	363	473	483	507	516	516	537
IM	429	526	567	627	636	636	636
INT	27	27	56	62	64	64	64
INT	115	127	152	152	155	155	155
FT	541	646	832	952	983	1064	1178
INT	200	213	219	228	236	236	288
INT	43	73	79	86	86	86	103
INT	83	106	106	125	132	132	132
INT	1280	1422	1523	1532	1635	1635	1635
IM	433	452	483	498	538	538	542
INT	32	48	58	74	86	86	86
FT	252	259	272	282	291	297	300
FT	81	102	118	133	159	159	159
FT	84	87	92	100	115	115	155
INT	298	364	375	428	430	430	430
IM	212	231	252	253	261	264	269
IM	214	214	214	217	225	226	226
INT	398	411	448	459	472	477	489
FT	255	261	273	297	300	300	305
IM	97	98	103	108	112	116	116
INT	558	674	796	900	1011	1011	1011
INT	365	469	520	566	577	577	577
FT	253	261	268	310	312	312	312
IM	181	206	215	223	231	232	232
INT	321	342	392	461	468	476	477
INT	309	317	323	331	336	336	336
average	276	310	340	364	380	385	394

The content of the cells presented in Tables 1 and 2 is highlighted in yellow to mark those days when the number of Page Views was the same as the day before. The longest period of inactivity corresponds to a student that did not increase the number of Page Views (70) over a period of 5 days. This inactivity might indicate the imminence of dropout, but interestingly this was in fact one of the best students in the class. The concerns raised by Canvas statistics were not justified in this case, confirming what was said above with respect to looking at Page Views as "a good approximation to student activity and not an absolute metric". Nevertheless there is a wealth of information available in these tables, providing an interesting insight into the progress of the class, including the differences between the most active and least active students, the class behavior on weekends, etc.

YouTube analytics

A total of 26 pre-recorded lectures were embedded into Canvas "Presentations" Pages, all of which were hosted in YouTube, where a diversity of analytics is available for each video (Google, 2021). The number of views and watch time are exemplified in Fig. 1 for the introductory "Welcome to this course" video. This video has a duration of 6:02 minutes and has been watched 71 times since it was published (on Oct 29th, approximately 1 ½ weeks before the course start), and until the end of the intensive lectures' week (Nov 19th). Since the total watch time was 3.0 hours, and considering that the 2021/22 CS4110 cohort size was of 30 students, this means an average of (3x60/30=) 6 minutes per student, just 2 seconds different from the total video length – which would be the same if each student had seen the entire video. It is therefore reasonable to assume that this video was effective and widely used as planned. The fact that it collected 71 views, however, indicates that the students did not watch it entirely in a single occasion, which prompts the possibility that 6:02 minutes may be too long for the attention span of younger generations.

YouTube analytics also inform about average view duration and percentage viewed, as shown in Fig. 2 for the same CS4110 "Welcome" video. This graph shows a stable retention rate over the complete video length, which would not

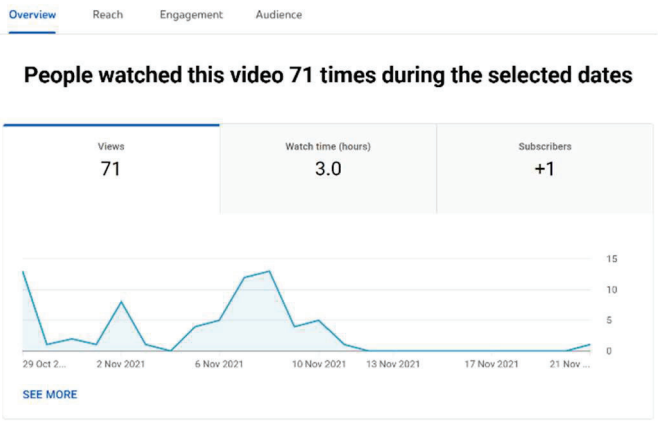

Fig. 1 Views/watch time for the "Welcome to this course" video

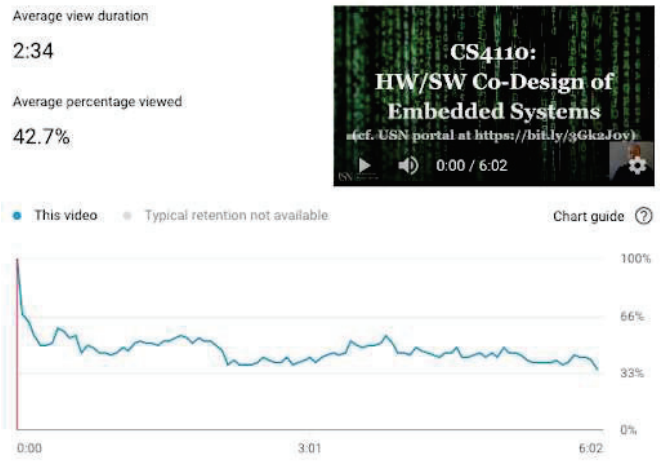

Fig. 2 Average view duration / percentage viewed

happen if there were problems with the quality of the video. When that happens, we will normally see an abrupt fall at the point where those problems occur, calling the attention of the teacher to the need of revising that content.

Zoom reports

Zoom provides "usage reports" detailing the time when each participant joins/leaves, as well as the total time of presence in each session. This data is important if there are minimum attendance requirements, which was the case of CS4110 (80% attendance in the intensive lectures' week). Apart from that, Zoom reports also account for the on-campus / online distribution of the students, which is important when they can choose their mode of participation.

On-campus teaching and learning continues to be the most relevant form of course delivery, but flexibility will be maximized by letting the students choose how they want to participate, and by allowing them to take that decision until the last minute before the session start. When this happens, the number of students in the classroom will of course depend on the added value provided by attending on-campus. The Zoom data for the reading and intensive lectures' weeks of CS4110

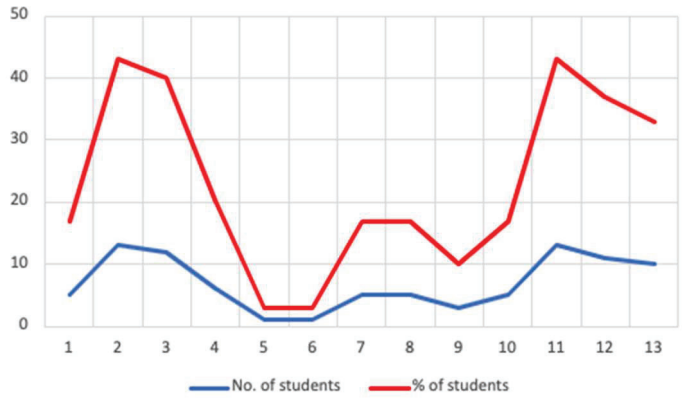

Fig. 3 Zoom reports data (reading and intensive lectures' weeks)

is shown in Fig. 3. On-campus attendance was entirely optional during the reading week, and recommended during the intensive lectures' week, when online participation was essentially related to light illness of some students.

CONCLUSION

The standard tools available to USN teachers offer a wealth of learning analytics that can be used to enhance the quality of teaching and learning practices. Canvas Page Views offers a good example, which is frequently neglected by the teachers, possibly for lack of time, but possibly also for lack of awareness of what this information represents, and how it can be used. Particularly important in the case of flipped-classroom models (Bakheet & Gravell 2021), where pre-recorded lectures play an important role, the analytics information provided by YouTube offers a valuable insight into the quality of this type of e-learning content, and on how it is used by the students. Finally, the Zoom reports offer details about online participants, and may be used not only to check for minimum attendance requirements, but also to assess how a course will be received in future scenarios where students will have a higher degree of freedom concerning their mode of attendance.

The wealth of information available to the teachers also raises a different sort of questions. The analytics information commonly provided by YouTube enables the teachers to evaluate the usefulness and quality of their pre-recorded lectures, but nevertheless preserves the anonymity of the viewers. It may be questionable that this does not happen in the case of the statistics provided by the e-learning platform, where the digital footprint is associated to each student. This is particularly worth of notice because higher-education institutions generally do not have a policy of asking for their consent, contrary to what happens in commercial services as those provided by Google. This may need our attention in the near future, both to ensure compliance with data protection regulations (GDPR, 2016), and also to motivate and engage the cooperation of the students.

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