Redesigning Course Curriculum for Quarantine Conditions: Experiences from two lecturers in software engineering

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ABSTRACT

The COVID-19 pandemic posed a challenge for teachers and students to adjust to continually changing restrictions in relation to teaching. In response to this challenge, we designed a new course structure for the class Data Analytics Infrastructure. Our aim was to actively engage students without knowing if we would conduct mostly online teaching or face-to-face teaching. This paper presents our experiences with redesigning a course under quarantine conditions to improve student motivation.

Keywords – active participation in online learning, (re)designing online courses, flipped classroom, motivation, COVID-19, blended learning, data analytics infrastructure.

Contribution – Explore Session

BACKGROUND

COVID-19 posed an adaptive challenge for teachers (Reimers et al., 2020) and is the largest disruption of education in history impacting students and faculty world-wide (Pokhrel and Chhetri, 2021) as schools have discontinued face-to-face teaching. In this paper, we would like to present our joint efforts to transform our course Data Analytics Infrastructure into a quarantine-proof online learning experience.

The course Data Analytics Infrastructure (DAI) is a fourth semester course in the Software Engineering program at VIA University College in Horsens[1]. The redesign of the course was carried out in the fall of 2020 and course material (videos, learning paths, etc.) was developed during early spring 2021. The first run of the course was in spring 2021.

DAI enables the students to design and implement infrastructure to support data analytics including tools and techniques for data acquisitions, data cleansing, data modelling and data visualization. The students in the course are fourth semester students who have completed the prerequisite course on database design (DBS). The course is a mandatory course in the Software Engineering program worth 5 ECTS through the European Credit Transfer Scheme. The course is open to exchange students coming to the institution for a semester.

102 students took the course in Spring 2021. 14 students took the class in Danish with Astrid as the instructor, 44 students took the class in English with Astrid as the instructor (Y class) and 44 students took the class in English with Knud Erik as the instructor (X class).

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[1] The course description can be found here: https://en.via.dk/tmh-courses/data-analytics-infrastructure

The students who took the course in spring 2021 had some previous experience in online education from the initial lock-down in March 2020. Both lecturers in the course were also teaching the course during the initial lock-down and thus had some preliminary experience in teaching the course in an online format, though not with the structure and materials described in this paper.

As a result of the pandemic, we decided to redesign the entire course format. We needed to think of a structure that would remain if we were allowed to return to in-class teaching. We also wanted to undertake the redesign in such a manner that the new course would also work in a regular teaching environment post-pandemic.

We have focused on building a learning experience that addresses the three fundamental needs of students: autonomy, competence, and relatedness (Deci and Ryan, 2001) to improve motivation which is essential in online learning (Salmon, 2004, p.15).

EXPLANATION

Traditional in-class lectures continue to be the predominant instructional strategy despite being criticized as being an ineffective instructional form (Gilboy, Heinerichs and Pazzaglia, 2015) with students generally only remembering 20% of what has been presented in class. Flipped classroom is one kind of online learning that promises to reduce the time spend on disseminating information (Johnson, 2013) in favor of increasing the time spent "challenging student thinking, guiding them to solving practical problems, and encouraging direct application of material through active learning with the instructor present" (Gilboy, Heinerichs and Pazzaglia, 2015) thus being a form of active learning and blended learning (Olesen, 2020).

Course designs for online learning vary and redesign towards online teaching may be based on different considerations (Twigg, 2003). Further, Twig (2003) proposes that online learning may reduce costs for institutions of up 40% and improve student learning (Twigg 2003, p. 30).

However, online learning may also be a challenge for students. Some learners may find it difficult to adapt and adjust whereas others may quickly adapt to the new learning environment (Pokhrel and Chhetri, 2021; Nwosisi et al., 2016). Some students may find it especially challenging to participate in online learning because of issues related to motivation and access (Salmon, 2004) and students with low digital competencies may experience problems with access to online materials (Salmon, 2004).

Surveys during the COVID-19 pandemic have found that students rate motivation lower, that they had less contact with fellow students and with instructors (Zambach, 2020; EVA, 2021), which may further lead to demotivation as relatedness needs are not being met (Deci and Ryan, 2001).

Feedback is important for learning (Hattie and Timperley, 2007; Dolmer et al., 2016). Students in higher education want more feedback and especially formative feedback. According to EVA (2021), educators often fail to provide the right, structured conditions for a feedback culture. When participating in online learning the need for constant feedback is apparent for confident as well as less confident learners (Salmon, 2004, p.16).

SET UP

We decided to redesign the DAI course into a blended learning model with asynchronous activities which the students completed and received feedback on, as well as synchronous activities that students would complete together in order to serve motivation needs related to socialization.

The course redesign is split into three tracks. Each of these three different learning experiences cover the same learning aims. See Figure 1 below.
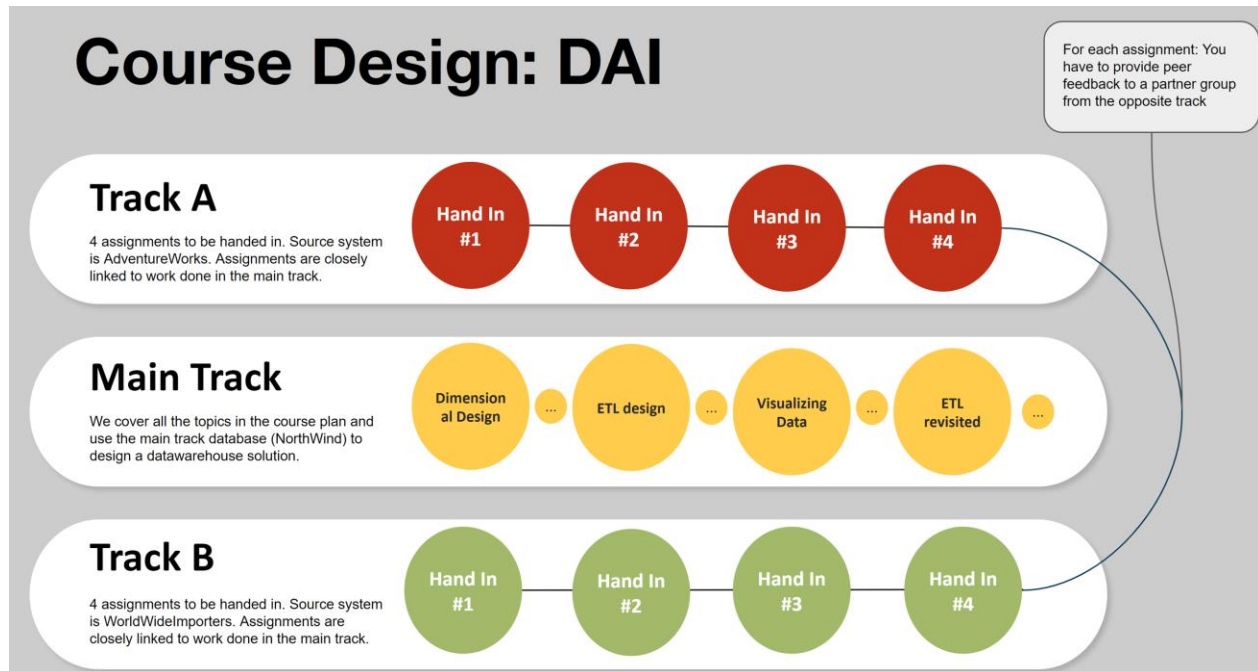

Figure 1: Course Design

In the main track, students complete individual exercises aimed at building competence in the different learning aims for the course. This learning experience is supported with learning resources, focused on dissemination as well as individual and group practice. The learning experience was supported using learning paths in the online Learning Management System itslearning.

Two of the learning aims of the course are: " Use basic statistics and visualization to find and explain patterns of information in data" and "Discuss and argue pros, cons and trade-offs of choices". The structure of the course is exemplified for these learning aims in Figure 2 and Figure 3 on the following pages.

Before starting the course, the students are asked to complete a small prologue which take the form of a learning path like the ones they will be working with in the course. The prologue introduces the students to the course, the lecturers, and our expectations of the students. We have done so because more than just simple access to online materials, students need to know how to participate (Salmon, 2004).
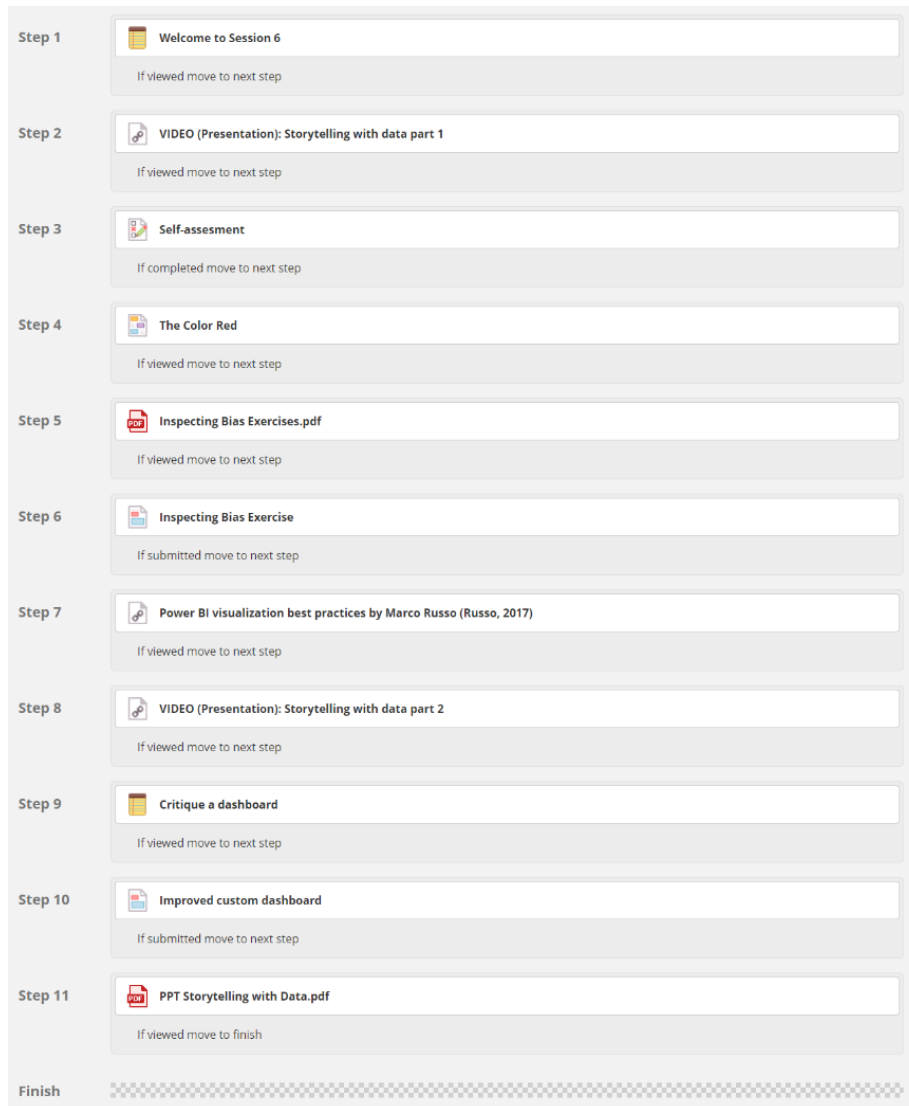
Figure 2: Example of Learning Path

These learning paths allows the teacher to structure the course content in such a way that resources are accessed in succession and even allows for setting conditions on progression. This allows the teacher to create a path with an intentional didactical causality in the materials presented (Krogh, Christensen and Qvortrup, 2016, p.305). Further, inspired by the buffet model (Twigg, 2003), supplementary resources are offered to the students (see Figure 3) in addition to the learning path ("Flipped Teaching Session 6"). All learning paths in the course have been developed using the same structure.

The learning paths should take the average student between 1,5 and 2 hours to complete depending on the session. The learning paths are done by the students ahead of the scheduled class-time as an asynchronous activity (cf. Olesen, 2020).

Different methods are used to assess student performance in the classroom. Namely observations, conversations, and student materials (Vilslev and Rønn, 2006), which may be used to provide the student with feedback. In an online setting the act of observation becomes more difficult, and conversations are

typically affected by the need to have microphones turned off in large gatherings. To serve the feedback needs of students, we designed the course with three different feedback mechanisms in mind.
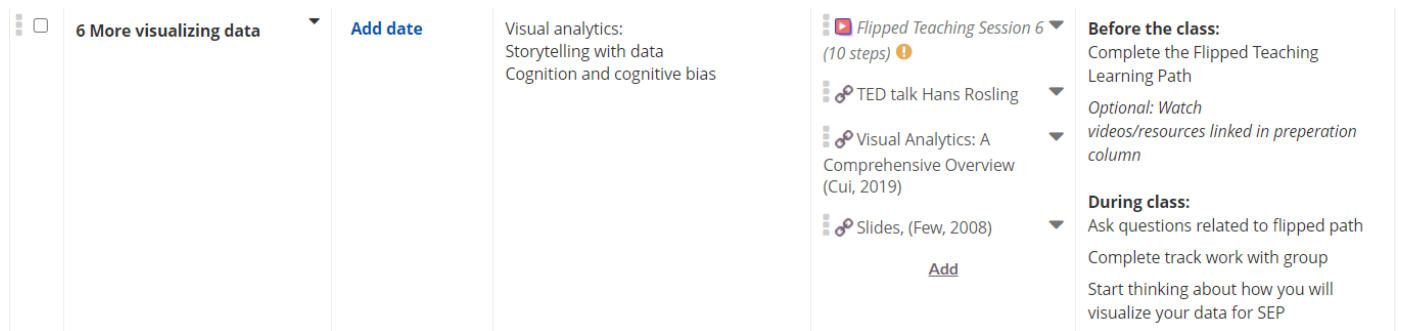
6 More visualizing data ▼	Add date	Visual analytics: Storytelling with data Cognition and cognitive bias	▶ *Flipped Teaching Session 6* ▼ *(10 steps)* ⚠	**Before the class:** Complete the Flipped Teaching Learning Path
			🔗 TED talk Hans Rosling ▼	*Optional: Watch videos/resources linked in preperation column*
			🔗 Visual Analytics: A Comprehensive Overview (Cui, 2019)	
			🔗 Slides, (Few, 2008) ▼	**During class:** Ask questions related to flipped path
			Add	Complete track work with group
				Start thinking about how you will visualize your data for SEP

Figure 3: Example of structure and supplementary materials

For the individual main track, the students would receive individual feedback either from teachers (formative feedback) or from a self-administered multiple-choice test (summative feedback). To receive feedback from the teachers, the students were instructed to complete the individual exercises minimum 24 hours before class start.

The student tracks (Track A and Track B) were developed as a collaborative project that forms the basis of their final, individual evaluation at the end of the semester. The students complete the group assignment in self-chosen groups of maximum four people. Beyond the work done in the course, the students also use their knowledge from the course to complete a 5 ECTS points semester project (similar to a capstone project) providing the students with several learning practices that have proved beneficial to student learning (cf. Kuh, 2008)

In the student tracks, the students would peer-assess each other's hand-ins based on correction sheets provided by the teachers as students need concrete criteria to use for their assessment of others work (EVA, 2021). For an example of a peer feedback correction sheet, please see Appendix 1.

The type of feedback students were required to give each other was formative and students were instructed to consider the feedback carefully as opposed to following the guidance provided blindly. In case of doubt, they were encouraged to discuss the feedback given and/or received with the instructors. Peer feedback was given and received group-wise and was not anonymous as anonymity makes the students feedback more critical and divergent from the educator's feedback (EVA, 2021).

All instructional material created by the teachers was uploaded to a YouTube channel and linked from the course website on itslearning[2]. Most videos in the course were 5-10 minutes long with some exceptions with videos that were 15-20 minutes long due to the nature of the subject. This is in accordance with what others have suggested as an optimal length for media (Fidalgo-Blanco et al., 2016; Franciszkowicz, 2008; Johnson, 2013).

In addition to the videos recorded for disseminating the course material and providing instruction videos for how to design and implement the data infrastructure, we recruited three practitioners to participate in supplementary video material showing how data analytics infrastructure is applied in practice. These videos

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[2] The interested reader may refer to https://astridhanghoej.dk/dataanalyticsinfrastructure/ to see some of the course materials created for this course.

were generally longer and most of them were offered as supplementary material in accordance with the buffet model for online learning (cf. Twigg, 2003)

RESULTS

In this section, we would like to present the preliminary results of the course redesign evaluation using both quantitative and qualitative data. The quantitative data is gathered from the course evaluation survey, the LMS platform, third party platforms (e.g. YouTube) as well as grades from the exam system (WISEflow™).

Quantitative data
In Appendix 2, quantitative course evaluation data is shown for all three classes. In the Danish language class, 12 out of 14 students responded to the survey. In the English language classes, 37 out of 44 and 36 out of 44 responded to the survey. Yielding response rates of 85.71%, 84.09% and 81.82%, respectively. The response rate is considered good in comparison to typical response rates for online evaluations which may range from as low as 17 up to 83 percent according to a literature review by Ahmad (2018) with online response rates typically being around 50 percent.

In the course survey, we evaluated students' attitudes towards the course in relation to autonomy, relatedness, and competence as well as their overall attitude towards the course (see Appendix 2). We further asked the students to assess the different types of learning resources/methods used in the course in terms of their self-evaluated learning outcome.

We also collected qualitative data from the students by asking them "What worked well in this course?", "What would you like to see more of in this course? and giving them the opportunity to provide "Suggestions for improvements".

Students had an overall positive attitude towards the atmosphere in the class (majority of student answered agree or strongly agree). Most students likewise indicated that they perceived a high degree of freedom in the class. Less than half of the students indicated that they felt competent in the class (see Appendix 2).
In one class, almost 20% of the students taking the course evaluation survey stated that they did not have a good feeling towards the course with 13,9% stating disagree and 5,6% stating strongly disagree. (11% disagree, 0% strongly disagree and 8,3%, 0% strongly disagree respectively in the other classes). However, attitudes towards the flipped course format were not as favorable as Nwosisis et al (2016) in which 94% of students had a positive perception of flipped learning.

One student reported failure to complete the exercises in the learning paths in the course evaluation survey. However, all students completed the learning paths prior to concluding the semester (prerequisite to attend the exam). Not all students managed to complete all learning paths before each weeks' class. The requirement to complete learning paths ahead of class was mentioned by some students in the open-ended questions on the course survey (see section on qualitative data) as a restriction and as requirement that they would struggle to fulfill.

Using YouTube quantitative data on video views, we see that students revisit material later. In fact, the highest number of views on the YouTube channel were achieved during the exam period (see spike in Figure 5 below) across all the videos on the YouTube channel for the course. This shows that students used the accessibility of materials to further engage with the material when the extrinsic motivation to do so presented itself (the week of the exam for the course).
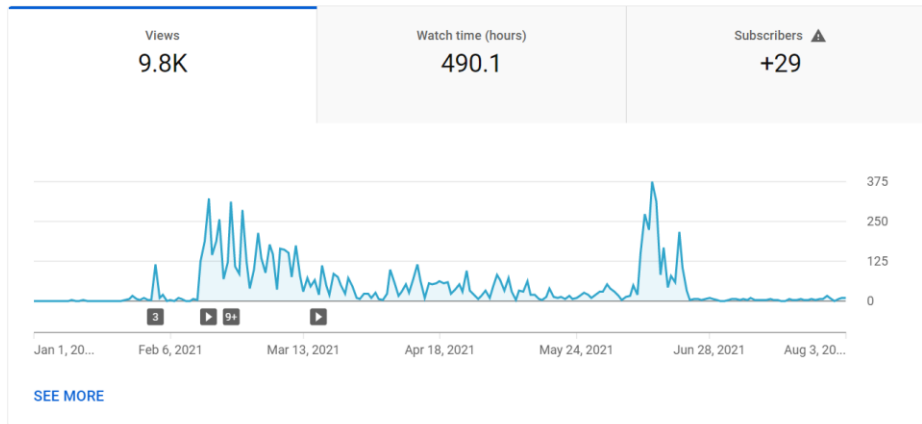
Figure 4: Video views (aggregated across the entire channel) of teaching materials

On the YouTube channel, we are provided with metrics for the videos uploaded. Most views on the channel come from students taking the course as most views arrive from external attribution through the itslearning website; however, some views were also reached through organic attribution on the YouTube platform as some videos were posted as publicly available.

Looking at the audience retention metrics for one of the videos, we can see the following chart:
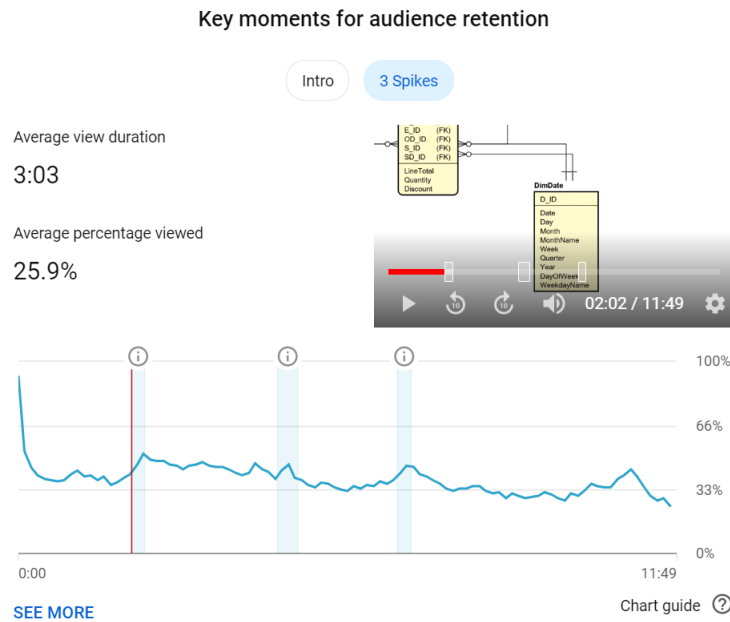

Figure 5: Video Analytics (Key moments for audience retention).
Percentage of retained viewers per segment watched (mm:ss)

In the above figure, the x-axis represents the timeline of the video measures as mm:ss and the y-axis percentage retained viewers. The graph shows are that there is a drop in viewers in the first minute of the video, but once the viewers "stick around" the audience retention remains uniform throughout the video.

We are also provided with three shaded bars that show the spikes in viewer retention. This may indicate that viewers return to watch parts of the video again – either through interest or to repeat parts of the material that was hard to understand.

In the quantitative data from the YouTube channel, we can see the number of overall views for each video. Videos posted later in the semester received fewer views than those earlier in the semester in accordance with the overall trend of views in Figure 4. Optional videos (not included in learning paths or indicated as such in the learning paths) received far fewer views than mandatory videos included in the learning paths.

The opportunity to practice has been shown to improve student performance (Eddy, Converse and Wenderoth, 2015). Clicker questions have been shown to improve learning (Preszler et al., 2017). Students who were able to create their own explanations were better graded on exam questions than students simply reading expert explanations (Willoughby, Wood and McDermott, 2000; Wood et al., 1994). Further, video-material has been shown to improve preliminary test-scores when used as additional material to in-class teaching (Franciszkowicz, 2008, p.12). Repeated testing correlated with increased learning (Dunlosky et al., 2013).

From the learning management system, we can export data on the student's activity in the course room. This allows us to compare the students time spend on course webpage with the final grade for the course. Students who did not attend the exam have been omitted from the analysis.

Comparing time spend on learning paths and student performance (grades), we see that there is no clear linear relationship. However, students who received the highest grade have spend noticeably more time on course material (average 713,5 minutes) than other students (average 522,55 minutes). See Figure 6 below:
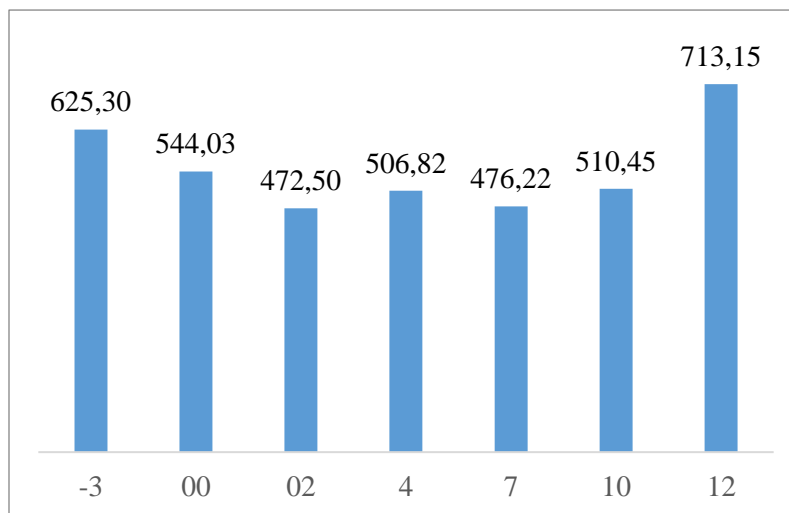

Figure 6: Average time spend on course webpage (in minutes) by final grade of the semester

ANOVA test for differences in variance were not significant and we cannot reject the null hypothesis that at least two of the groups have significantly different means.
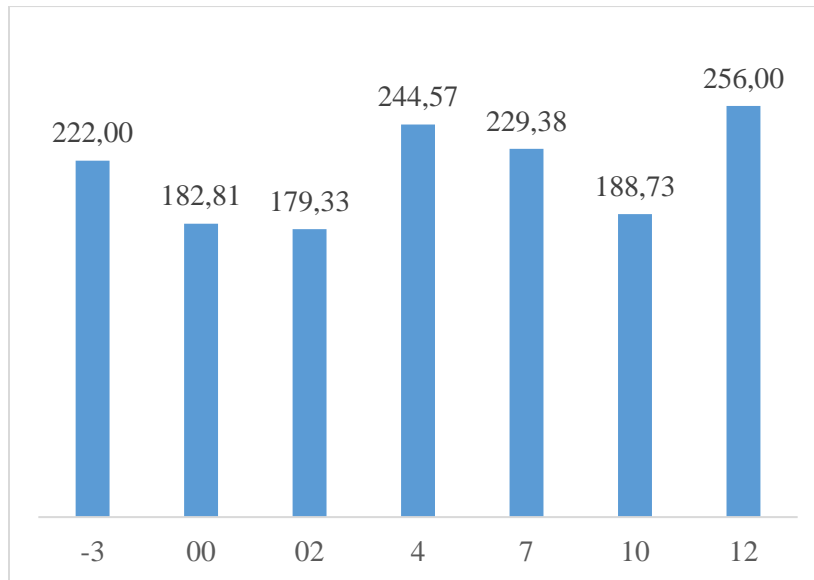
Figure 7: Average number of visits to course website by final grade of the semester

Comparing number of visits to course website and student performance (grades) in Figure 7, we see that there is no clear linear relationship.However, ANOVA test for comparison across number of visits to course website by final grade of the semester were significant (p-value 0.00192, one-sided). One-sided t-test assuming unequal variances showed that students who received the highest grade (12) had different mean of website visits than students who got 10 (p-value 0.00789) and the grades 00 (p-value 0.01328) and 02 (p-value 0.01126). Students who got a 10 had a different mean of website visits than students who got a 4 (p-value 0.03570).

Data on course website engagement may be noisy. Time spend on course webpage only captures the time the student has been logged into the course webpage. Actual engagement with material cannot be adequately measured and students may "leave" the course webpage to pursue materials hosted on third party platforms (e.g. YouTube videos, Kimball website etc.). Further, students may collaborate on the learning paths which may only add to the time spend metric for one student while in fact it should be attributed to all students pursuing the learning efforts collectively. The number of visits to course website may therefore be a better indicator of student activity since it requires actual engagement (clicks to course website). However, this metric may also not adequately track student engagement when students decide to work together on learning paths.

Qualitative data

In the open-ended questions in the course survey several themes emerged. The themes were: peer review, group work, structure and lastly the nature of the course format.

Qualitative data suggested that peer review divided the classroom. Some students commented "Working in the groups and getting peer review was pleasant to do" or "more peer review would be nice", whereas others commented "I don't really think that peer reviews are very useful or helpful. I would prefer to get feedback for group assignments from teachers", "peer review seems useless" or "I sometimes feel like it was useless doing them".

Many students commented on the group work. In general, students commented positively on the group work

stating that it was nice to do, improved communication, helped understanding. One student commented on group work and explained:

"Group work, since it is easier when we are communicating between each other while doing the assignments, knowing what we're all supposed to work with."

While another student wrote:

"Working in teams was very nice because we could merge our understanding upon the theory or the tasks we have to do, and we managed to learn together and that is very helpful for me. By doing things together I got to understand more about the subject"

These student expresses an opinion in which the students can use the group work as a mechanism for formative feedback. The students can compare different views on the subject and arrive at a mutual understanding of the material and use this knowledge to solve the problem at hand collaboratively.

Some students appreciated the structure of the course. Comments said:

"[Teachers name] is really good at helping and structures the class well."

"The atmosphere, pacing and structure of the course are nice. There are clear segments of what needs to be done before something else and that helps with knowing if you are behind or not. The learning paths are a great idea"

"It is good that we are able to complete all activities before class so if we have any questions, we are able to ask."

"[The] structure of the course [worked well]"

Among the comments on the structure of the course format, many student commented that it was nice to have the videos to return to later and/or rewatch to improve understanding. They mentioned that the way the videos were tailor-made for the flipped format made them more accessible than complete recordings of lectures. This is in accordance with Gilboy, Henrichs and Pazzaglia (2015) who find that students generally like the ability to watch videos as opposed to lectures.

Most comments that we got in the course evaluation were on the nature of the course, which divided the students. Among some of the positive comments that we got, students said the following:

"[I liked] The idea of learning paths and having to get acquainted with the information before the actual class"

"Flipped learning paths are a good idea. They remove the boring stuff from the classroom" (translated from Danish)

"Flipped Learning Paths are a great idea. You are forced to go over everything" (translated from Danish)

While others were less appreciative of the format:
"this course is change for the sake of change - standard format is a lot better"

"don't know what exactly worked well in this course. It felt strange from the beginning and confusing so that a lot of people I think lost interest. But if one kept being consistent and worked the proposed plan and exercises it starts to click and the concepts start to make sense."

"not a big fan of the flipped teaching. feels like twice as much as work while doing nothing in the actual class"

"The flipped teaching just doesn't work well in this format. In the class we don't do anything apart from (maybe) ask for some advice. Otherwise, there is no incentive to wake up in the morning and join the zoom when we can work on these at any time."

"it feels like it's a last-minute generated mess".

"I think it's annoying that you have to complete the learning paths ahead of the lecture." (translated from Danish)

"I like the videos, but I think it's annoying that you have to complete them before the class. I would rather do them after class, especially since Monday [day of the class] is a long day" (translated from Danish)

Most of the negative comments came from one class out of three parallel classes that semester.

The end of semester survey showed that the students in the class did not read the book associated with the class. Data shows 33.3%, 24.3% , and 16.7% of students reporting that they did not use the book.

CONCLUSIONS

In the following section, we would like to conclude our paper by summing up our findings from the result section as well as presenting our recommendations for other teachers who may be interested in redesigning course curriculum to a flipped learning format.

We found that our redesign addressed the students need for autonomy and relatedness. Students had a positive attitude towards the atmosphere in the class. This could indicate that we were successful in designing a learning experience that catered to the student's relatedness needs. Most students likewise indicated that they perceived a high degree of freedom in the class which may indicate that we were successful in designing for their autonomy needs. The course redesign may however benefit from considering how we may improve the students feeling of competence as less than half of the students indicated that they felt competent in the class.

Contrary to previous findings, we do not find that student engagement with course material in the flipped learning path appears to improve performance at the exam. I.e. students who spend more time engaged with learning materials did not receive a higher grade than those who spend less time engaged with the learning materials.

In the qualitative data from the end-of-semester survey, four themes emerge as the most prominent: group work, course structure, peer review, and the nature of course format. In our data we also see that some students may perceive the format as too strenuous making them part of the group that Olesen (2020) refers to as "De opgivende" (in English: "The quitters"), who place responsibility for learning on the teacher rather than adopting a reflective and socially engaged approach to learning.

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We would like to end this paper by presenting our practical recommendations for colleagues who may consider redesigning courses for online teaching:

Collaborate with other educators to minimize overtime.
There are no short-term gains in redesigning for unknown quarantine restrictions. More than 700 hours went into designing this course in addition to time spend in-class. Each video of approximately 10-15 minutes could easily take an entire day to produce – even more if post-editing was not kept at an absolute minimum. Producing audio and visual material is time consuming which is consistent with what other educators have found (e.g. Atlason, 2017) and course redesign should thus be approached as a collegial process (cf. Nwosisi et al., 2016).

Ensure management support.
Management support should be ensured both for extra time to prepare, but also because students may have adverse reactions to a different format and more time will be spend on following up with these students. The overtime related to a course design is especially heavy in the first take of the course when no material has been created yet. The overtime related to students who have adverse reactions may persist until the students learn to adapt to changes in course formats. Educators may also benefit from thinking about how they might early on identify students who may have adverse reactions.

Start with low hanging fruits
Are there learning aims that may be adequately served with existing material? Careful: It takes a lot of time to screen material and existing material may not fit with the intended didactical narrative causing intentional didactical causality to be difficult to achieve.

Prepare the students for change in format.
A prologue explaining the format may not be enough, be prepared to continuously follow up on your expectations regarding the format. Students may appreciate the heavily structured course format but may experience difficulties in a new learning format. Some students may find it especially hard to adapt - Be prepared to follow up with these students – and think about how you might identify them when your ability to observe students may be obstructed because of lack of in-class presence.

Modularize your material/videos.
Not everything is going to be perfect in the first try – and if you avoid making videos too specific it makes it easier to replace them with a new version later. Think about how you may strike a balance between making videos interlinked and making them replaceable and/or reusable in other contexts. As we developed the materials for this course, another colleague (who teaches an elective course in the last year) found the videos and included them in his teaching. Since creating materials is a very time-consuming process, you may benefit by "thinking ahead" and creating material that may fit several agendas.

The generalisability of our findings is clearly limited by the conditions imposed by the ongoing pandemic and experiences from teaching the class using the flipped materials may be different as we return to face-to-face teaching.

REFERENCES

Ahmad, T., 2018. Teaching evaluation and student response rate. *PSU Research Review*, 2(3), pp.2399–1747.

Atlason, R.S., 2017. Benefits of using podcasts as supplementary teaching material. In: J.B. Røn, ed. *Exploring Teaching for Active Learning in Engineering Education*.

Deci, E.L. and Ryan, R.M., 2001. *Extrinsic Rewards and Intrinsic Motivation in Education: Reconsidered Once Again*.

Dolmer, G., Motes de Oca, L., Mølgaard, H. and Qvortrup, A., 2016. *Feedback inspirationshæfte. VIA Pædagogik og Samfund*.

Dunlosky, J., Rawson, K.A., Marsh, E.J., Nathan, M.J. and Willingham, D.T., 2013. Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest, Supplement*, 14(1), pp.4–58.

Eddy, S.L., Converse, M. and Wenderoth, M.P., 2015. PORTAAL: A Classroom Observation Tool Assessing Evidence-Based Teaching Practices for Active Learning in Large Science, Technology, Engineering, and Mathematics Classes. *CBE - Life Sciences Education*, 14(2).

EVA, 2021. *Studerendes oplevelse af feedback på videregående uddannelser*. [online] Available at: <https://www.eva.dk/videregaaende-uddannelse/studerendes-oplevelse-feedback-paa-videregaaende-uddannelser> [Accessed 5 Aug. 2021].

EVA, 2021. *Trivsel blandt førsteårsstuderende under hjemsendelsen i foråret 2021*. [online] Available at: <https://www.eva.dk/studietrivsel_forår_2021> [Accessed 6 Sep. 2021].

Fidalgo-Blanco, A., Martinez-Nuñez, M., Borrás-Gene, O. and Sanchez-Medina, J.J., 2016. Micro flip teaching - An innovative model to promote the active involvement of students. *Computers in Human Behavior*, 72, pp.713–723.

Franciszkowicz, M., 2008. Video-Based Additional Instruction. *Journal of the Research Center for Educational Technology (RCET)*, 4(2).

Gilboy, M.B., Heinerichs, S. and Pazzaglia, G., 2015. Enhancing Student Engagement Using the Flipped Classroom. *J Nutr Educ Behav*, 47, pp.109–114.

Hattie, J. and Timperley, H., 2007. The power of feedback. *Review of Educational Research*, 77(1), pp.81–112.

Johnson, G.B., 2013. *Student perceptions of the Flipped Classroom*. University of British Columbia.

Krogh, E., Christensen, T. and Qvortrup, A., 2016. Vidensform og handleform, analyse og modeller. In: *Almendidaktik og fagdidaktik*.

Kuh, G.D., 2008. Excerpt from high-impact educational practices: What they are, who has access to them, and why they matter. *qubeshub.org*.

Nwosisi, C., Ferreira, A., Rosenberg, W. and Walsh, K., 2016. A Study of the Flipped Classroom and Its Effectiveness in Flipping Thirty Percent of the Course Content. *Article in International Journal of Information and Education Technology*.

Olesen, M.I.K., 2020. Jeg vil have rigtig undervisning! Profiler af blendede learnere i efter-og videreuddannelsen. *Tidsskriftet Læring & Medier (LOM)*, 20.

Pokhrel, S. and Chhetri, R., 2021. A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning: *Higher Education for the Future*, 8(1), pp.133–141.

Preszler, R.W., Dawe, A., Shuster, C.B. and Shuster, M., 2017. Assessment of the Effects of Student Response Systems on Student Learning and Attitudes over a Broad Range of Biology Courses. *CBE - Life Sciences Education*, 6(1), pp.29–41.

Reimers, F., Schleicher, A., Saavedra, J. and Tuominen, S., 2020. Supporting the continuation of teaching and learning during the COVID-19 Pandemic Supporting the continuation of teaching and learning during the COVID-19 Pandemic Annotated resources for online learning.

Salmon, G., 2004. *E-tivities: The Key to Active Online Learning*. Kogan Page Limited.

Twigg, C.A., 2003. Models for online learning improving learning and reducing costs.

Vilslev, B. and Rønn, C., 2006. *Udvikling af evalueringskultur*.

Willoughby, T., Wood, E. and McDermott, C.-… : T.O.J. of, 2000. Enhancing learning through strategy instruction and group interaction: Is active generation of elaborations critical? *Appli Cogn Pscyhology*, 14, pp.19–30.

Wood, E., Willoughby, T., Kaspar, V. and Idle, T., 1994. *Enhancing adolescents' recall of factual content: The impact of provided versus self-generated elaborations*. Albta J Educ Res.

Zambach, S., 2020. *Survey of educators' and students' experiences during the COVID-19 lockdown*. [online] Available at: <https://blog.cbs.dk/teach/wp-content/uploads/ShortDescHomePageV1.pdf> [Accessed 4 Aug. 2021].

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APPENDIX 1

<table>
<tr>
<td colspan="2" align="center"># Peer Review Correction Sheet
Hand in #1</td>
</tr>
<tr>
<td>Comment on ER-diagram
Does it have all relevant dimensions?
Does it follow star schema?
Is it linked to dimensional design approach?</td>
<td></td>
</tr>
<tr>
<td>Comment on design
Are dimensions/attributes linked to background description for its track?
Does it use Kimball terminology?
Does it include relevant attributes?</td>
<td></td>
</tr>
<tr>
<td>Comment on documentation
Is the SQL code there? Does it contain relevant commenting?
Are you able to run the code without errors (see section with installation guide below)?
Does it include source-target mappings?
Is everything documented/explained?
Are the transformations in datatypes explained? Do you agree with the groups' implementation?</td>
<td></td>
</tr>
<tr>
<td>Comment on installation guide
Did the installation guide explain what you had to do?
Were you able to install the data warehouse by following the installation guide?</td>
<td></td>
</tr>
</table>

APPENDIX 2: End-of-semester survey, quantitative data

Number of respondents: 12

1. Matrix question

Attitude

Please rate the following statements

	Strongly agree	Agree	Neither agree nor disagree	Diasgree	Strongly disagree	Not answered
In general, I have a good feeling towards this course	8,3%	50%	25%	8,3%	0%	8,3%
I feel competent in this course	16,7%	25%	33,3%	25%	0%	0%
I like this atmosphere in this class	25%	33,3%	25%	8,3%	0%	8,3%
I have a lot of freedom in this course	25%	41,7%	8,3%	8,3%	8,3%	8,3%

2. Matrix question

Perceived learning outcome

How much did the following resources help you learn in this course?

	Great help	Much help	Moderate help	A little help	No help	Did not use	Not answered
Completing the flipped learning paths	25%	33,3%	25%	16,7%	0%	0%	0%
Watching instruction videos (How to)	41,7%	33,3%	8,3%	8,3%	8,3%	0%	0%
Watching theory videos (PowerPoint)	16,7%	0%	33,3%	50%	0%	0%	0%
Watching videos with practioners	8,3%	41,7%	25%	16,7%	0%	0%	8,3%
Doing the individual exercises in the learning paths	33,3%	50%	16,7%	0%	0%	0%	0%
Interacting with the teacher	25%	33,3%	33,3%	0%	0%	8,3%	0%
Peer review exercises	8,3%	16,7%	33,3%	16,7%	25%	0%	0%
Group work on track assignment	66,7%	16,7%	16,7%	0%	0%	0%	0%
Reading the book	0%	8,3%	41,7%	0%	16,7%	33,3%	0%
Using the linked resources in plans (e.g. kimball website, SQL server documentation, datadeo etc.)	8,3%	0%	50%	33,3%	8,3%	0%	0%

Number of respondents: 37

1. Matrix question

Attitude

Please rate the following statements

	Strongly agree	Agree	Neither agree nor disagree	Diasgree	Strongly disagree	Not answered
In general, I have a good feeling towards this course	16,2%	37,8%	29,7%	10,8%	2,7%	2,7%
I feel competent in this course	10,8%	32,4%	43,2%	5,4%	2,7%	5,4%
I like this atmosphere in this class	13,5%	37,8%	27%	10,8%	5,4%	5,4%
I have a lot of freedom in this course	35,1%	40,5%	16,2%	5,4%	0%	2,7%

2. Matrix question

Perceived learning outcome

How much did the following resources help you learn in this course?

	Great help	Much help	Moderate help	A little help	No help	Did not use	Not answered
Completing the flipped learning paths	18,9%	29,7%	29,7%	13,5%	8,1%	0%	0%
Watching instruction videos (How to)	29,7%	37,8%	10,8%	16,2%	5,4%	0%	0%
Watching theory videos (PowerPoint)	13,5%	29,7%	18,9%	24,3%	13,5%	0%	0%
Watching videos with practioners	24,3%	8,1%	32,4%	29,7%	5,4%	0%	0%
Doing the individual exercises in the learning paths	13,5%	35,1%	37,8%	13,5%	0%	0%	0%
Interacting with the teacher	21,6%	37,8%	18,9%	10,8%	0%	10,8%	0%
Peer review exercises	5,4%	13,5%	45,9%	16,2%	8,1%	8,1%	2,7%
Group work on track assignment	24,3%	43,2%	21,6%	0%	8,1%	2,7%	0%
Reading the book	8,1%	16,2%	21,6%	27%	2,7%	24,3%	0%
Using the linked resources in plans (e.g. kimball website, SQL server documentation, datadeo etc.)	16,2%	18,9%	27%	27%	2,7%	8,1%	0%

Number of respondents: 36

1. Matrix question

Attitude

Please rate the following statements

	Strongly agree	Agree	Neither agree nor disagree	Diasgree	Strongly disagree	Not answered
In general, I have a good feeling towards this course	2,8%	33,3%	44,4%	13,9%	5,6%	0%
I feel competent in this course	5,6%	30,6%	41,7%	19,4%	0%	2,8%
I like this atmosphere in this class	5,6%	27,8%	44,4%	16,7%	5,6%	0%
I have a lot of freedom in this course	16,7%	36,1%	33,3%	8,3%	5,6%	0%

2. Matrix question

Perceived learning outcome

How much did the following resources help you learn in this course?

	Great help	Much help	Moderate help	A little help	No help	Did not use	Not answered
Completing the flipped learning paths	11,1%	16,7%	38,9%	19,4%	8,3%	5,6%	0%
Watching instruction videos (How to)	30,6%	36,1%	22,2%	11,1%	0%	0%	0%
Watching theory videos (PowerPoint)	5,6%	25%	27,8%	27,8%	13,9%	0%	0%
Watching videos with practioners	11,1%	22,2%	25%	16,7%	13,9%	5,6%	5,6%
Doing the individual exercises in the learning paths	19,4%	22,2%	27,8%	25%	2,8%	2,8%	0%
Interacting with the teacher	13,9%	27,8%	19,4%	19,4%	2,8%	16,7%	0%
Peer review exercises	8,3%	16,7%	19,4%	27,8%	25%	0%	2,8%
Group work on track assignment	36,1%	36,1%	13,9%	13,9%	0%	0%	0%
Reading the book	8,3%	11,1%	27,8%	25%	11,1%	16,7%	0%
Using the linked resources in plans (e.g. kimball website, SQL server documentation, datadeo etc.)	13,9%	13,9%	33,3%	27,8%	2,8%	8,3%	0%