Video portfolio as an exam option in a database course

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Abstract. What happens when we provide database students with a choice of selecting between two different exam types? Do you want to display your skills and knowledge through a traditional three hour school exam, or do you want to display them by creating a video portfolio?

This paper describes a specific case where the students at Kristiania University College got that choice. A new video portfolio exam was piloted for three years. The results from the pilot are presented and discussed in relation to related topics such as flexible assessment, Open Educational Resources, portfolio and, most importantly, learning.

Portfolio students self-report that they learn more through a portfolio assessment than a traditional school exam, and the exam results indicate the same. But after piloting for three years, only 10% of the students chose portfolio as their final exam. We try to understand why the numbers of portfolio students were so low, and the students' thoughts behind the exam choice.

Video portfolio exam comes with an extra assessment cost and there are challenges in regard to plagiarism. Looking ahead, we try to describe how we may use some of the perceived benefits of using a video portfolio exam into our teaching. How may we be provide students with similar learning activities without risking an increase in plagiarism cases and assessment costs?

Keywords: video portfolio · learner-generated screencasts · flexible assessment · OER · database education.

1 Introduction

DB1100 is a 7.5 ECTS introductory course to databases within Bachelor in IT at Kristiania University Collage (KUC). Approximately 200 students are introduced to relation databases with three major topics: SQL, database modeling and normalization.

Weekly assignments play an important role in the course. Students solve relevant assignments alone or in groups. A variety of standard lectures and flipped classroom sessions support the students in solving the assignments.

The course completes with a three hour school exam. The format of the exam has been fixed for several years using different cases within the three main course

topics. The students create SQL statements, they model a database and they evaluate an existing database in regard to normalization.

As part of the KUC research project "Min drømmeeksamen" (My dream exam), funded by Norgesuniversitetet, we piloted an optional exam format. Students could choose to create a video portfolio as opposed to take the final three hour school exam.

The starting point of the portfolio was to find a case of interest. The student chose a case within a domain they personally found interesting. It could be an online gaming tournament, recipes for baking cupcakes or anything else. A student could start working on a portfolio and decide midway through the course if they wanted to sign up for a portfolio exam or the traditional school exam. If they did not manage to make a choice, the default choice was the traditional school exam.

The portfolio in the first pilot year consisted of 9 videos and 2 documents (with minor adjustments in year 2 and 3). One document described the domain. The other document was a database script to build the database the student had created as part of the portfolio. The nine videos were:

- Video describing and explaining the database model with minimum 5 tables.
- Video describing and explaining the submitted database script including a demo of running the script.
- Video explaining the normal form of the database using relevant terms such as functional dependencies.
- Video demonstrating how to create database users with limited rights in the database .
- 5 videos explaining and demonstrating various SQL statements relevant for the database.

The target group for the videos was *someone interested in learning about relational databases* - in addition to the examiner. The total length of the videos was 45-60 minutes.

The students delivered videos within certain deadlines and received feedback from teacher assistants and the lecturer. This was changed to peer review in year 2 and 3 of the pilot. The students could change and adjust their videos after receiving feedback.

This experience paper examines the outcome of the three years of piloting video portfolio as an exam option in the database course.

2   Background

Multiple definitions of educational portfolio exists. One of the most commonly used definitions is by Paulson et al. [9]: A portfolio is a purposeful collection of student work that exhibits the student's efforts, progress, or achievements in one or more areas. The collection must include student participation in selecting contents, the criteria for judging merit, and evidence of the student's self-reflection (p. 60).

The portfolio in DB1100 does not fulfill all the criteria in the definition above. The students created their own case of interest, and they selected what types of SQL statements they would produce for their database. But the overall selection of content was limited. The portfolio did not include evidence of student self-reflection. The delivered portfolio did not include earlier work in order to document progress. The criteria for judging merit was how well the candidate was able to explain and demonstrate relevant topics, described as learning goals within the course, using a self-selected case.

When delivering the videos, the students were encouraged to openly publish them. The alternative was to use an open platform (such as YouTube), but restrict the access by using appropriate links. The motivation for publishing the videos was two-folded. Firstly, the students were introduced to the concept of Open Educational Resources (OER) and how they, by creating OER, could contribute to other people's learning. Secondly, the students got the opportunity to start building a portfolio of work that could enrich their documentation of learning achievements when later applying for a job.

The term OER origins from an UNESCO forum in 2002 where OER were described as "The open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes" (cited in [6]). Weller [12] differentiates between "big and little OER", where big OER are produced institutionally and for the specific purpose of learning. Little OER are individual contributions and may be created from a variety of motivations. Weller argues that a mixed economy of big and little OER could be the best best route to realising open education.

The videos in DB1100 could be described as little OER. Individual contributions do not need to be produced by faculty staff. Keegan et al. [8] argue that in OER discussions the emphasis is on *teachers* as the producers. They describe an AR project where the *students* were producers of educational content for future cohorts: "Rather than focusing on open media resources produced by expert practitioners for use by peers and learners, we examine the practice of learners as active agents." By creating films using mobile phones, the students produced OER and provided benefits in terms of knowledge sharing and community participation.

The portfolio students in DB1100 created the videos using screencasts - recordings on their computer screen. Reyna and Meyer [11] describe learner-generated screencasts as being "only a recent emerging trend in higher education, and the literature is scarce". They place learner-generated screencasts within the concept of Learner-Generated Digital Media (LGDM).

Student-generated videos as learning resources have recently been implemented in multiple chemistry settings (e.g. [3, 5, 7]). When Gallardo et al. [4] review student-generated videos in chemistry education, they place the student activity within a framework of generative learning theory [13, 14] (cited in [4]) and *learning science by understanding*: "This generation requires active construction, so that learners take actions that purposefully utilise new knowledge to develop

an understanding, thus making connections between new information and what they already know."

Providing students with exam options is a form of *flexible assessment.* Pretorius et al. [10] provide an example within a subject on management accounting. The students could choose between two or four summative assignments. Pretorius et al. argue that the flexibility in assessment allows students to take a proactive role in their learning. Earlier work by Cook [2] describes a similar case where students in an economics course had one compulsory final exam, but could also *choose* to participate in other summative assessment activities. She found that flexible assessment was well received by the students, allowing them "some power of choice and thus a feeling of being more in control of their own learning approach."

When evaluating the outcome of piloting a choice of video portfolio in DB1100, we investigate the following research question: **How do students experience having a choice between a traditional school exam and a video portfolio exam?** When investigating the experience, we use the following sub-questions in the context of educational portfolio, flexible assessment, OER and learning:

– Do students prefer video portfolio over a traditional three hour school exam?
– What factors matter when a student chooses between a video portfolio and a school exam?
– Do students believe they learn more from having a video portfolio exam than a traditional school exam?
– Do students find use of video material produced by students in earlier cohorts?

3   Method

To answer the research question, we used a mixed approach of semi-structured interviews, surveys and observations. Table 1 provides an overview of the different types of data collected throughout the pilot period.

Table 1. Collected data

	2017	2018	2019
Course evaluation questionnaire	n=55 (30%)	n=82 (41%)	
Portfolio evaluation questionnaire		n=11 (41%)	n=10 (40%)
Interviews	6	8	
Exam results	2013-2019		
Observations	2017 by lecturer and paper author		

We interviewed six students from cohort 2017. Four of them had chosen video portfolio, two had chosen school exam. The 2017 interviews were conducted by an educator from another educational institution. Eight students were interviewed

in 2018. These interviews were conducted by two educators - the lecturer from the 2018 cohort and the lecturer from the 2017 cohort. Four of these eight students had chosen video portfolio and four had chosen the school exam. All interviews were transcribed.

In 2017, two questions regarding exam options were included in the course evaluation. Both questions were open-ended:

- Why did you choose the form of assessment you chose?
- Do you believe that your choice of assessment had any effect on how much you learned in the course?

We received 55 responses with an answer rate of 30%.

In 2018, a part of the course evaluation included learning resources in the course. As the 2018 students had access to some of the portfolios created by the previous cohort, we asked the 2018 students how they perceived the value of the different learning resources in the course - including the student portfolios. 82 students participated in the survey (41%).

In 2018 and 2019, students having chosen the portfolio exam answered a questionnaire with questions related to the assessment form. The students were asked to rate statements on a likert scale (1-5). The surveys also included open-ended questions regarding positive and negative outcomes of choosing the portfolio exam.

We collected exam results both from cohorts prior to introducing portfolio (2013-2016) and during the portfolio pilot period (2017-2019). In the latter period we collected results from both the traditional exam and the portfolio exam.

4   Results

A clear result from the data collection was that students who chose the portfolio exam were happy about their choice. Beginning with the survey targeted at the portfolio students in 2018 and 2019, table 2 displays the results from the survey.

Although the number of respondents are low (n=21 out of 52, response rate = 40%), the average scores on the likert scale (1-5) indicate that the students were satisfied, They agree that they have a learned a lot from teaching others (4.6 avg.) and that working with the videos (including peer assessment) helped them reach their academic goals (4.6 avg.). Further, they agree agree that their influence on what to present in the videos gave the content of the course greater relevance (4.6 avg.), and that working with the videos provided a good connection between theory and practice (4.5 avg.). We also notice that the students did not strongly believe that making the videos made them more attractive as a job seeker (3.7 avg.).

Choosing between video portfolio and school exam With high student satisfaction with the video portfolio in year 2 and 3 of the pilot period, it could be

Table 2. End of term survey for students having chosen portfolio exam.

Question	2018		2019		Total	
	n	avg	n	avg	n	avg
I have learned a lot from teaching others through the introductory videos I have published	11	4.7	10	4.5	21	4.6
Working on the videos and peer assessment helped me reach my academic goals	11	4.5	10	4.7	21	4.6
The fact that I influenced what I presented in the videos gave the content of the course greater relevance	11	4.6	10	4.5	21	4.6
Making instructional videos has made me more attractive as a job seeker	11	3.6	10	3.7	21	3.7
The connection between theory and practice became clear through the work with the videos	10	4.5	10	4.5	20	4.5

reasonable to expect that a higher portion of the students chose the assessment form. During the three pilot years, only 62 out of 617 students (10%) chose video portfolio as the assessment form. We find answers to the low participation numbers through observations, surveys and interviews.

When introducing video portfolio in 2017, the assessment format was new to both faculty staff and students. When informing about the exam option in class early in the course, many questions were raised by the students. A large portion of the questions regarded video production and publication. They were unsure what was expected to be delivered. And they were sceptical to publish their work for others to see. As a consequence, we removed the initial requirement that the videos should be published openly. The students could choose to hand in video links where the links were needed in order to watch the videos.

When asking students on their thoughts on whether or not to choose video portfolio we get mixed answers. 55 students responded to the course evaluation survey in 2017. Of those 55, 87% had (self-reportedly) chosen school exam and 9% had chosen video portfolio (4% unanswered).

The main reason for **not** choosing video portfolio was the large amount of time needed to produce videos. As video production and editing were not learning goals within the course, some students did not want to spend much time on those activities. The list below includes other mentioned factors (most mentioned factor in bold).

- **takes too much time to produce and edit videos** / laziness
- shyness / uncomfortable hearing own voice in video / do not want others to see my videos
- uncertainty / the familiarity with the traditional school exam and exam preparation
- not having enough skills and knowledge to be able to produce the videos / find it hard to explain relevant topics

The most common reason for the students who chose the video portfolio was *to learn more*. Some also mentioned that it was something new, and trying something new is interesting. It was also considered more practically oriented.

The interviews from 2017 and 2018 provide more insight into the decision process of the students. Students who chose the video portfolio felt they had more control over the assessment. They could invest a lot of time throughout the semester and make sure they understood the topics well enough in order to produce the videos. That is in contrast to the traditional school exam where a student can "have a bad day", or be confronted with a specific small topic that they do not know well.

> "It's so typical that there's one thing you have not studied so well, and that is exactly the thing you get on the exam."

> "Suddenly you are sick, suddenly you have not slept enough. Suddenly something happens that makes you not perform at your best."

The fact that the traditional school exam was the default assessment choice was also a factor. Some students did not manage to make up their mind, and therefore ended up with the school exam.

There was one major difference between the student interviews in 2017 and 2018. Some 2018 students chose video portfolio because of recommendations from students in the previous cohort.

Assessment and learning We saw in table 2 that the portfolio students responding to the survey in 2018 and 2019 were happy about their choice. They agreed that video portfolio made it easier to achieve their academic goals and that they learned a lot from teaching others.

An open-ended question in the 2017 survey asked the student about their view on assessment and learning: "Do you think that your choice of assessment form had any effect on how much you learned in the course?" All (self-reported) portfolio students answered "yes", and adding arguments such as:

- More exiting to create my own database and perform SQL statements with it.
- Through the videos, I had to understand what I was talking about.
- Continuous deliveries made me not place the subject on hold.
- In traditional exams, what you write will be forgotten shortly afterwards.

The students who chose the school exam had mixed answers. Some answered a clear "No", while others were uncertain. Some wrote they would have liked to do the portfolio exam, but were reluctant due to certain characteristics mention earlier, such as having to hear their own voice. Some wrote that they might have learned more if they had chosen the portfolio exam. A few were quite certain that they would have learned more:

> "I think so. When you are assessed on your videos, you really have to learn the topics and produce the material, while when you are going to have an exam, you can wait until the last minute to prepare."

"Yes, I'm a huge fan of portfolio assessment. Then you must know the subject so well that you are able to teach it. I regret that I did not choose to continue with it."

The interviews in 2017 and 2018 shed some more light on the assessment form and learning. One portfolio student believed he was able to see a difference during the course:

"I also noticed along the way that when we had discussions with non-portfolio students, we portfolio students knew more."

One of the interviewees described the learning involved in the process of creating videos:

"I thought, it's not for me [video portfolio]. But then I thought I should try making that video. It was a video about join and group by, if I remember correctly. How we create the queries. But when I made it, I was very unsure about group by. So then I thought, ok, I can make a video about it. And then I started reading about group by. And read more and more and more until I understood it. The problem was that I did not have time to make the video, so I did not make any video there and then. But I had understood so much more of join and group by that I thought, ok, this might be something for me because then I really have to read through everything and try to understand instead of just reading through. [...] Then I started making those videos, and adding them to a portfolio. So I think it's a very effective learning method instead of taking a written exam. Because I feel like I have to work twice as hard as if I had just taken the exercises every day, and that was it. Because you have to understand why it's like that. Because you have to explain it in your own way with your own database and your own modeling, your own db script, your own normalization. So you have to make everything yourself. And that's what I think is great. Because now, I've learned all about it."

The portfolio evaluation surveys in 2018 and 2019 did also indicate that the portfolio students perceived that they learned more than the students who chose the school exam. One very enthusiastic 2019 student wrote:

"It has been an absolutely wonderful alternative to the boring outdated written exams. To have to produce something means that one really has to understand what you are going to make a video about. This is how exams should be in all subjects. It is not for everyone to sit down with a theory test. I can say with certainty that I know more about DB than an A student who had a written test. This is because I have put the whole topic into practice, instead of just learning the theory around it."

Table 3 displays the exam results from previous years (2013-2016) and the pilot years (2017-2019). We see that the Grade Point Average (GPA) is fairly

stable for the students taking the 3 hour school exam (between 2.5 and 3.1). Vi also see that the portfolio students had a higher GPA in all the pilot years, although the GPA was declining (4.1 to 3.8 to 3.6).

We can not conclude that portfolio students learned more than the other students based on these exam results. The obvious limitation is that the students chose their exam form, and we may expect the more eager students to choose a portfolio including additional work. But we see clearly that only a small portion of the students chose the portfolio exam. And each year, those how chose the portfolio exam got better average grades than those who did not.

Table 3. Exam results from 2013 to 2019.

	3 hr school exam							Video portfolio		
	2013	2014	2015	2016	2017	2018	2019	2017	2018	2019
A	11%	7%	13%	6%	13%	16%	11%	30%	33%	32%
B	17%	19%	22%	20%	15%	26%	25%	60%	33%	32%
C	25%	25%	36%	33%	35%	23%	27%	0%	11%	12%
D	23%	20%	24%	19%	19%	16%	26%	10%	22%	12%
E	17%	20%	1%	10%	7%	12%	10%	0%	0%	8%
F	7%	8%	4%	12%	10%	8%	1%	0%	0%	4%
gpa	2.6	2.5	3.1	2.6	2.8	2.9	3.0	**4.1**	**3.8**	**3.6**
n	195	231	169	172	175	174	206	**10**	**27**	**25**

Student videos as learning resources Students in DB1100 have since 2018 had access to student portfolios from earlier cohorts. The portfolios have been publicly available on open platforms and links to playlists have been published in the course Learning Management System (LMS). A variety of playlists have been selected by the lecturer on a yearly basis. Some playlists have been selected from the previous cohort, and some from earlier cohorts. Approximately five playlists have been selected each year based on quality in both content and presentation. The playlists have been presented as additional learning resources.

As part of the course evaluation in 2018, we presented the course learning resources and asked the question: To what extent have the following learning resources contributed to your learning in the course? Figure 1 displays the results (Likert scale 1-6).

We see from figure 1 that all the presented learning resources contributed to some degree to the students learning. The textbook was rated lowest (3.66) and slides were rated highest (5.16). Although the course was run in a flipped classroom setting, every session included slides as a form of composed content in contrast to the textbook. When solving exercises, the slides were a place to look (or search) when in need of specific help. In between the textbook and slides, we find video playlists from former students (4.03). We see that the video
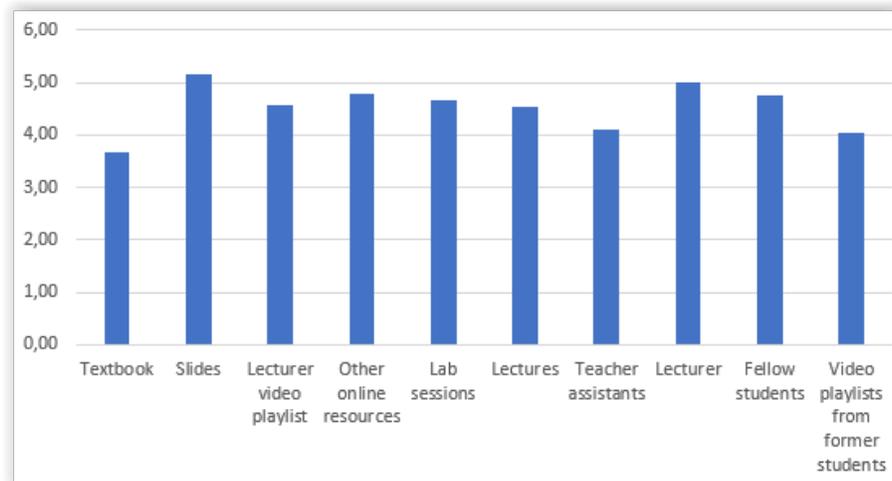
Fig. 1. To what extent have the following learning resources contributed to your learning in the course? Likert scale 1-6. n=82 (41%).

playlists produced by the students were rated lower than the playlist created by the lecturer (4.58), and only rated higher than the course textbook.

6 out of the 8 interviewed students in 2018 used student portfolios from the previous cohort as learning resources. The reasons for using the videos were different for the portfolio students and those who chose the school exam. Those who chose the school exam described two major reasons for using the videos - for variation and to get alternative input on difficult topics:

"To mix it up a bit. I think it's nice to not just read but to have three different settings. One where you sit and work with it, one where you sit and watch videos of others who explain it, and one where you sit and read. Or else, it can get a little dull."

"Especially after a while [they became useful]. Not at first, because I think in the beginning that everything was fine, but when things got a little harder it was; okay now I need them. Because now I need someone to explain it once more and preferably five times in a row in one way and in a slightly different way as well."

The interviewed portfolio students, on the other hand, primarily used the videos to see examples of how to produce a video portfolio.

The students described a benefit of having multiple portfolios to choose from and videos were in some ways easier to understand than reading a textbook:

"Yes, it has a bit to do with how how people present. I like people who are a bit like me. [...] it's kind of someone that explains in our way and

when you have several different students, you'll often find a video that "snaps", so you understand exactly what is meant."

"It was like when I found a playlist I liked, I stuck to it. [...] It is perhaps a different type of language that is most important. Textbooks have their own language which can be a bit like formal formulations. But most people do not when they speak. And it is not necessarily more difficult to read the textbook, but it just feels more time consuming because one has to sit and think "what does that sentence really mean", what do they mean when they write it? While if someone just talks about something then there are a little more superfluous sentences. But they are nice because they are more often easier to listen to."

5   Discussion

To measure learning is difficult. Some of the criteria of the educational portfolio is to include work that exhibits the student's progress and self-reflection in addition to efforts and achievements [9]. Our use of portfolio in DB1100 did not include signs of progress or self-reflection. Thus, it is harder to measure learning having taken place.

But we do have clear indications that students having chosen portfolio exam (or our loose definition of video portfolio) have learned more than those who did not. Portfolio students self-report that they have learned more, and the exam results indicate the same. We also find results that can help explain *why* they may have learned more.

The portfolio students report that for them to produce videos they had to *really understand*. This is also reported by non-portfolio students who regret not choosing portfolio assessment. The portfolio students chose their own, individual, case of interest and had to incorporate what they learned into the case. From their individual starting point, they had to construct new knowledge. This is in line with the recent use of student-generated videos within chemistry education where the activity of producing the videos was placed within generative learning theory and *learning science by understanding* [4]. The students made connections between new information and what they already knew.

If students possibly learn more from a video portfolio exam than a school exam, why not remove the school exam option completely? Our non-portfolio students presented different explanations on why they chose the school exam. And these students were the large majority (90%). From our findings, the main reason for not choosing video portfolio was the video format. Video production is time consuming, and some students find it hard to hear their own voice in the result.

Figure 2 places DB1100 in the context of constructive alignment [1] prior to the portfolio pilot. The elements changing for students choosing portfolio is highlighted in bold and marked with an asterix(*).

For the portfolio students, the intended learning outcomes are the same, but the assessment has changed. The portfolio students no longer need to prepare
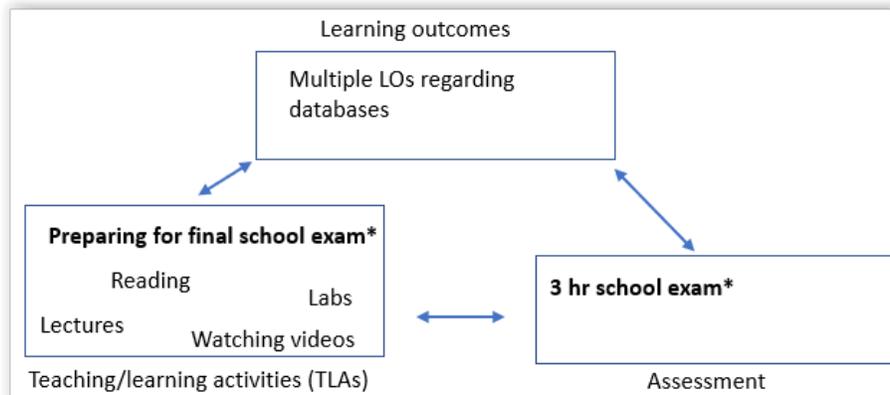
Fig. 2. TLAs, learning outcomes and assessment pre pilot. For portfolio students, "Preparing for final school exam" was replaced by portfolio work, including receiving and providing feedback. The 3 hr school exam was replaced by video portfolio.

for a final school exam. They invest time in producing the portfolio and provide and receive feedback as part of the process. The other TLAs were the same for all students. We have seen how students describe the learning involved when producing the videos and how they needed to *understand* before creating them.

The extra time put into the portfolio could be considered a form of trade off. The portfolio students invested extra time steadily during the semester while receiving (and providing) feedback along the way. But the same students did not have an intensive study period prior to a final school exam. And as multiple students mentioned; intensive studying prior to a final exam often results in knowledge vanishing shortly afterwards.

When piloting the video portfolio, we did not try to recruit as many students as possible. We gave every student the opportunity, but we reminded them that they would need to invest additional time. The main reason for not aiming at as many students as possible was assessment costs. The time involved for assessing a video portfolio is higher than for a 3 hr school exam. The total length of the videos were 45-60 minutes. Assessing one portfolio exam could take approximately 90 minutes. In large classes, 90 minutes per exam could be problematic.

We also foresaw challenges with plagiarism. If all 200 students created an openly available portfolio each year, it would become increasingly hard to trust the authenticity of each portfolio. In a smaller scale with 10% of the students working with a portfolio, it is manageable to follow the students and their progression. Including signs of progression and self-reflection in the portfolio could also help in regard to review the authenticity of the work.

6   Conclusion and future work

The video portfolio students built their portfolio rooted in a domain of their own choice. It was a domain they already knew, or had an interest in knowing more about. Through the portfolio work, they constructed new database knowledge within that familiar domain. As the target group for the video watcher was *someone interested in learning about databases*, they took a role as a teacher. They really had to *understand* in order to produce the videos. Our results suggest that the portfolio work, as a TLA, enhanced learning as opposed to preparing for a final school exam.

The pilot period also resulted in additional learning resources for future cohorts. Future students have a set of playlists where former students explain database concepts within different domains and with their own personal touch. An *individual* learner may find a former student that explains concepts in a way that matches their specific preferences.

The video portfolio exam option worked well within a pilot project for three years. Only 10% of the students chose the video portfolio. The increased assessment workload was affordable, and we believe we managed to ensure the authenticity of the portfolios. But our setup has scaling issues. How may we include elements from the pilot period and avoid increased assessment costs and possible plagiarism cases?

One possible change is to keep the TLA, but remove the exam option. Students could have a coursework (mandatory or not) where they create their own database case within their own field of interest. They could also provide and receive feedback through peer assessment. As the main reason for choosing video portfolio by our students was to *learn more*, it is possible that students are willing to invest time in a coursework, as apposed to a video portfolio exam, in order to learn more. In the context of constructive alignment, the coursework TLA will have to align with the final exam. The final exam will have to be conducted so that the students clearly see that time spent on the coursework will help prepare them for the final exam.

The main reason for not choosing video portfolio was the amount of time involved in producing videos and the awkwardness of hearing themselves in the videos. The format of the coursework does not have to include video. Students may choose to describe their work in any form of media. In our specific case at KUC, the students have earlier video examples to look to for inspiration. But a similar set of little OER may be continuously produced in other formats.

References

1. John Biggs. Enhancing teaching through constructive alignment. *Higher education*, 32(3):347–364, 1996.
2. Averil Cook. Assessing the use of flexible assessment. *Assessment & Evaluation in Higher Education*, 26(6):539–549, 2001.
3. Susannah Gal. Using student insights for ideas on video creation for chemistry classes. *Journal of Chemical Education*, 97(9):3102–3105, 2020.
4. Maria Gallardo-Williams, Layne A Morsch, Ciana Paye, and Michael K Seery. Student-generated video in chemistry education. *Chemistry Education Research and Practice*, 21(2):488–495, 2020.
5. Krystal Grieger and Alexey Leontyev. Promoting student awareness of green chemistry principles via student-generated presentation videos. *Journal of Chemical Education*, 97(9):2657–2663, 2020.
6. John Hilton. Open educational resources and college textbook choices: A review of research on efficacy and perceptions. *Educational technology research and development*, 64(4):573–590, 2016.
7. Brittany A Hubbard, Grayson C Jones, and Maria T Gallardo-Williams. Student-generated digital tutorials in an introductory organic chemistry course. *Journal of Chemical Education*, 96(3):597–600, 2019.
8. Helen Keegan, Frances Bell, et al. Youtube as a repository: the creative practice of students as producers of open educational resources. *European Journal of Open and Distance e-Learning*, 2011.
9. F Leon Paulson, Pearl R Paulson, and Carol A Meyer. What makes a portfolio a portfolio. *Educational leadership*, 48(5):60–63, 1991.
10. Lynette Pretorius, Greg P van Mourik, and Catherine Barratt. Student choice and higher-order thinking: Using a novel flexible assessment regime combined with critical thinking activities to encourage the development of higher order thinking. *International Journal of Teaching and Learning in Higher Education*, 29(2):389–401, 2017.
11. Jorge Reyna and Peter Meier. Learner-generated digital media (lgdm) as an assessment tool in tertiary science education: A review of literature. *IAFOR Journal of Education*, 6(3):93–109, 2018.
12. Martin Weller. Big and little oer. In *OpenED2010: Seventh Annual Open Education Conference*, November 2010.
13. Merlin C Wittrock. Learning as a generative process. *Educational psychologist*, 11(2):87–95, 1974.
14. Merlin C Wittrock. Generative science teaching. In Peter J Fensham, Richard F Gunstone, Richard T White, and Richard Thomas White, editors, *The content of science: A constructivist approach to its teaching and learning*. Falmer Press, 1994.