Students as Prosumers: Learning from Peer-Produced Materials in a Computing Science Course

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***Abstract* — This paper presents an investigation of a pedagogical approach where student act as prosumers of peer-generated knowledge. A cohort of computing science students were tasked to interview field experts, and then produced a report of the interview results in the form of a short video accompanied by a written summary. The reports were used to facilitate learning about aspects and phases of IT systems life cycle. This paper investigates student and instructor attitudes to and experiences of this pedagogical approach. Our findings suggest that the students were generally not ready for this learning method, which led to the "love it or hate it" split within the observed cohort. While the instructing team was convinced of the benefits of the used pedagogical approach and planned to continue using it in future, they were faced with a number of challenges. The biggest of those challenges was that the instructors had no control over the quality of teaching materials, which affected learning experience of the students. This paper's findings contribute to the understanding of CS student and instructor expectations, attitudes, and experiences of non-traditional teaching and learning activities such as creating videos and reusing student-produced multi-media materials.**

Keywords* — *peer-learning; student-generated content; learning through making; active learning; computing science education

I. Introduction

Traditional models of teaching are instructor-centred, viewing students as *consumers* of knowledge from their professors. Students are expected to synthesise facts, while assessments, such as exams and coursework, are designed to test how effectively the students can restate the information that they have passively ingested.

Today, modern technological advances, particularly Web 2.0, emphasise user content creation and collaboration. The trend of shifting the spotlight to users of technology leads to similar changes in more conservative aspects of our lives, such as education. Modern pedagogies focus on student-centred approaches; furthermore, students increasingly work in technology-supported environments and are tasked with assignments that require artefact creation. The students therefore gradually become *both producers and consumers* of knowledge as well as teaching & learning materials.

Numerous studies have demonstrated the many benefits of student-centred pedagogical approaches where *students being creators* e.g. [1]–[3]. However, most often the created artefacts are short-lived; they only serve the purpose of assessing the students' work, and at best are used as examples from previous iterations of the course. *Peer-assisted learning* [4] is another example of student-centred approach, which have been attracting scholars for many decades. While both *student content creation* and *peer-learning* are well-studied individually, very little has been written on the combination of the two approaches. Some work was done under the umbrella of Contributing Student Pedagogy (CSP) [5]. These studies have looked at theoretical and conceptual aspects of the pedagogy [6], [7], empirical quantitative evidence supporting its benefits [8], as well as techniques and tools that instructors use with it [9], [10]. However, there is still limited literature reporting qualitative results on the *instructor and student perception of this pedagogy* and the work presented in this paper is set out to address this gap.

The study, presented in this paper, was conducted at a Computing Science course, called "Complex IT systems in large organisations" where students acted as *prosumers*, that is, they produced a part of the course learning materials, and also consumed/learned from the parts that were created by their peers. This study was centred around the Self-Flipped Classroom (SFC) pedagogical approach [11]. A detailed theoretical background and our initial experiences with SFC were outlined in our earlier work, see [12]. This approach extends the Contributing Student Pedagogy by focusing particularly on student creation of multi-media (most often video) materials that are later reused for teaching other students in Flipped Classroom format.

Our focus in this paper is two-fold. First, we study the student attitude towards and experience of creating multi-media materials as part of assessment within a studied course, as well as their acceptability and experience of learning from such materials produced by their peers in the same cohort. Therefore, our first two research questions are as following:

RQ 1: *What are the student attitudes to and experiences of creating multi-media materials as a form of assessment?*

RQ 2: *What are the student attitudes to and experiences of learning from materials created by other students?*

Second, we explore attitudes and experiences of instructors who taught the course, analysing their activities during the course and challenges that Self-Flip Classroom brings into their teaching practice. Thus, our third research question is:

RQ 3: *What are the instructor attitudes to and experiences of the self-flipped teaching and learning methods?*

The results of this study contribute to the understanding of the overall perception of the SFC approach in CS education.

II. Related Work

Collis and Moonen [6], who first wrote about CSP, studied a mix of *peer-learning* and *learning through making* concepts. CSP emphasises the process of learning by engaging students as co-creators of learning resources. The notion was further researched and developed in several works by Hamer et al, for example [5], [10]. The principles of CSP originate from constructivist [13] and socio-cultural constructivist [14]

cognitive theories, and the theories of knowledge sharing and development through communities of practice [7].

The core element of CSP is the explicit creation of tangible, identifiable artefacts by one or more students for the purpose of being used by other students for their own learning. Such artefact creation is aligned with the *learning through making* approach and is supported by numerous studies suggesting that students who are engaged in the creation of digital artefacts demonstrate a higher level of thinking and deeper learning, which then leads to improved academic performance e.g. [3], [15], [16]. Moreover, evidence suggests other benefits, such as: multi-media production helps students to better engage with the subject and to look at the material from a different angle [17]; it also stimulates the development of creativity and critical thinking skills [18]. Examples of student-generated content effectively introduced into the curriculum, include multiple-choice questions [3], editable wiki-pages [1], narrated animations [17], digital games [19], and video tutorials [20].

A few recent studies explicitly investigated students in the role of prosumers of audio-visual materials. Thus, for example Engin [20] explored student-created videos as a resource for second language learning and concluded that this helps students to learn better. Notably, Engin found tension between students as producers and students as consumers with regard to valuing student-produced materials and learning from them. In another study carried out in the field of education and fine art [21] students from five undergraduate degree programmes produced various audio-visual materials to be shared openly with other learners through a digital platform. The authors of the study noted that in the prosumerism settings the students were forced to be out of their comfort zone of passive learners – they had to think and behave differently, which was challenging for many students. The paper furthermore highlights that one of the other challenges of using student-generated materials as part of curriculum was that the instructors were no longer in control of the results: it was hard to predict the outcome of student creations, which impacts the teaching and learning process.

Although, the above studies are informative, we did not find any examples of student prosumers of audio-visual materials from Computing Science or IT engineering courses, which motivated us to conduct our study.

III. Study Context

The studied course was a newly designed module introduced for the first time in spring 2018. It was offered at the "Masters in Software and Information Technology" programme as a compulsory module for a specialisation called "Human, Machine and Society". The course was specifically designed to emphasise active and student-centred learning.

The learning objectives of the course were related to stages such as development, procurement, implementation and maintenance in the life cycle of complex IT systems in various large organisations. The main learning outcomes of the course were: (i) the ability to describe potential challenges arising in connection with the development and introduction of IT systems in large organisations, as well as appropriate methods to address them; (ii) the ability to describe the challenges and problems that occur during procurement or development of systems intended for different user groups, and methods to deal with these; (iii) the ability to propose an appropriate solution for a given problem situation, as well as the ability to discuss advantages, disadvantages and applicability of the proposed solution.

The teaching materials for the course included reading of a popular novel on software engineering problems, "The Phoenix Project: A Novel About IT, DevOps, and Helping Your Business Win" [22] and several scientific papers in the area. The course delivery was in the Flipped Classroom style, based on seminars, and included active learning techniques (e.g. student discussions, debates and presentations) as well as artefact-creation exercises, such as interviewing field experts. The coursework was a combination of both individual and group assignments.

For the group project assignment, the students were tasked to conduct an interview with a selected field expert and, based on the received answers, create a rich but concise description of the expert's work. This description had to be in the form of a short instructional video and a text report which would be suitable for other students to learn from. Each group, comprising three to four students, were given a particular aspect of the IT system life cycle (e.g. development, procurement, implementation or maintenance), as well as a particular type of organisation where the system was in use (e.g. healthcare services, a commercial organisation, or public authority). Then, based on the selected combination (e.g. implementation plus commercial organisation, or maintenance plus healthcare), each group received contact details of a corresponding field expert, with whom the course instructors had an agreement for participation in the study activity. Each selected combination was hence only addressed by one group of students.

In the beginning of the semester, the students received training on how to conduct work place interviews and were supported in preparation of their questions for the field experts. The students also learned how to make instructional videos and were given access to equipment such as video cameras and microphones, if needed. One of the instructors' recommendations for the final videos was to avoid using video coverage of the actual interviewee. Instead, the students were encouraged to either re-enact the interview or present it in another format, synthesising the experts' answers into a short and clear informational artefact. According to the instructors' evaluation and the student feedback, the best videos in the course were made in the forms of an interview re-enacting, a news report, or a TV talk show. Some of the less popular videos were made using presentation slides with a voiceover recording, or a one-person narration. See Figure 1 and Figure 2 for screenshots of two video examples.

Figure 1. Screenshots from a video where students re-enact an interview they conducted with a field expert in the format of a TV news programme.

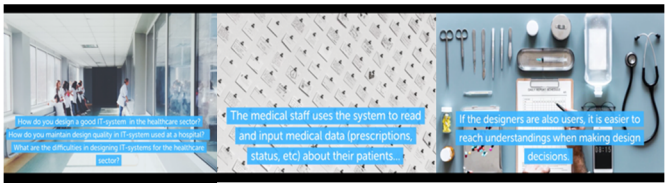

Figure 1. Screenshots from a video where students present results of an interview with a field expert in the format of a narrated slide deck.

In the second part of the semester, after all of the student groups completed their projects, the videos and text reports were shared among all the students in the class in order for them to learn about all the processes of IT systems life cycles in all of the studied organisational contexts. In this way, each group project contributed to building of a bigger collective picture of various IT system life cycles. After watching the collectively created videos and reading the text reports, students took part in discussions during seminars using the techniques of *constructive controversy* [23] and *affinity diagram* [24] to stimulate peer learning. One of the seminars was related to the different processes and the students met other groups that had worked with the same process such as procurement. In the second seminar the students met with other groups who had done interviews and films with people from the same area such as health care. According to Daniels and Cajander [25], the learning theory of constructive controversy posits that through discussions and controversies where learners seek to reach a general agreement between conflicting information, ideas or opinions, they find a starting point to understanding complex issues and solving difficult problems. At the same time learners also discover new facts and develop critical thinking skills. The affinity diagram technique was used to support students in classifying and organising the information they found as the result of their group projects. Both of these techniques stimulated learning through productive sharing of the student group project results. In contrast to simple in-class presentations, the two techniques aimed at providing a better opportunity for students to actively learn from each other. The individual exam that the students had to do at the end of the course included the information presented in videos and the text reports produced by all of the groups.

IV. Methods

The study involved two kinds of research participants: instructors and students.

The instructors were: (i) a course leader (referred to as 'CL' in the results) – a Human Computer Interaction professor, holding an esteemed title of *Distinguished University Teacher*, with extensive teaching experience who proposed and designed the course; and (ii) a teaching assistant (referred to as 'TA' in the results). The teaching assistant was a PhD student who had previously worked as a teaching assistant in other courses for several years prior to being involved in this course. Both of them agreed to give a research interview about their experiences of using the Self-Flipped Classroom techniques while teaching the studied course.

The students who took part in the course were at the Master level, specialising in "Human, Machine and Society" path of their degree programme. In total, 47 students took the course (the spring 2018 semester cohort). A self-selected sample of research interview participants comprised 12 students, i.e. 25,5% of the total study population, referred to as S1, S2, S3, etc. in the results. Two of the participants were female (S8 and S12), three of the participants were international students (S1, S2, S10), while the rest (9) of the participants were local. The demographics of the sample was consistent with the overall demographics of the course cohort.

The main data collection method for this study was semi-structured interview with open-ended questions [26], conducted with the students and the course instructors after the end of the course. The interviews lasted from 30 to 45 minutes and were audio recorded with consent from each of the interviewees.

In addition to the interviews, the research data comprised student videos and the final course evaluation results. The final course evaluation was conducted by the course instructors in the form of a survey with 10 multiple-choice questions, nine open-ended questions and an option to leave additional comments and suggestions. In total, 30% of the students (14 out of 47) completed the course evaluation. Some of the questions in this evaluation survey were directly relevant to the research questions of this study, such as student satisfaction of the course and their attitude towards creating and reusing the videos and text reports. We therefore present student answers from the survey along with the interview results below.

All of the interview audio recordings were transcribed and subsequently thematically analysed using the inductive approach [27], [28].

V. Results

The inductive thematic analysis of the interview data yielded several themes associated with student and instructor attitudes and experiences of the teaching and learning in the course. In the next four sub-sections, we discuss these results in detail and, by adding the course evaluation outcomes to the student interviews, we answer our research questions, in order.

A. Student Attitude

This sub-section discusses general **attitude of the students** to the Self-Flipped teaching and learning methods used in the studied course which helps to answer the first part of the **RQ 1** and **RQ 2**.

All but one interview respondents said that their overall impression of the course and its delivery methods was positive. For example, S7 said: *"It was a good course, it was a good experience, it was very enjoyable!"*; and S5 added: *"I think it's a really good way to learn, but it's harder to make it work really good. I'm not saying it worked bad in this course, but I think they could make it a lot better."* The most negative opinion came from S9, who criticised the course for not being challenging enough and not providing enough of teaching material: *"More material needs to be on the master level course. This one was like a two-weeks work"*. Still he said that conceptually the course had many good ideas, e.g. group projects covering different topics and the peer-learning through the exchange of the results of those projects (student-produced materials). S8, despite being generally very positive about the course, also commented that the course workload was not balanced and felt lightweight after the first half of the course.

The course evaluation survey, however, provided a different balance of the student responses where 57% (eight out of 14) of survey respondents were not satisfied with the course. Moreover, both the course leader and the teaching assistant mentioned in their interviews that they had a strong impression that the students in general had a "love it or hate it" attitude towards the course. These facts suggest that more students with positive attitude about the course chose to participate in the research interview, which may have led to a not fully representative sample of the whole cohort.

It was very common for interview respondents to say that the course was very different from everything else they had

before in their studies. Some students even felt sceptical about the course at the beginning, as they did not anticipate that a course which did not teach technical skills (programming or mathematics) could be useful for them. However, as the course continued, the students found it to be interesting and even better than they expected. S3 noted: *"I actually felt like this course gave me much more than I expected, at the beginning."*

Indeed, the initial reaction of a majority of the students who signed up for this compulsory course was a surprise: *"it was something completely different – no coding"*, said S4. He added that he thought that the course name suggested learning how to build a complex IT system, not how to work in a team who deals with it. Everyone else commented on how different it felt to study such a 'not technical and not hands-on topic', which students were not prepared for. An absolute majority of interview participants said that they expected to learn how to code or to solve math problems in a Master's level IT and software engineering course. The whole approach to the student-centred learning was unfamiliar to this cohort. As S1 noted: *"I don't think people in the class were used to having this way of learning"*.

Regarding student attitude towards the coursework assignments they had for this course, the overall opinion was positive, with most of 12 interview respondents saying that they generally liked the coursework. However, according to both the interview responses and the course evaluation, the students saw more value in doing the interviews and writing the report parts of the assignment. The attitude towards the video making part, however, was quite mixed. S6 explained: *"I learned a lot by doing the interview and being there. We did the interview at their workplace and walking through their corridors and going into their meeting rooms and feeling the atmosphere of being at a real workplace - that gave me a lot"*. S5 added: *"The interviews were really good to learn how to interview at workplace, because in most situations you need to interview in some way. But video making itself, maybe not that important, I don't think I will ever use it"*. Also, seven out of 14 course evaluation survey respondents felt that the video making assignment *"was not at its place in this particular course"*; however, eight out 14 survey respondents admitted that it *"was a fun experience"*.

A possible explanation for the attitude is that, while creating their videos, some students did not understand how the video part should be different from the text part of their report, and that, in fact, they should complement each other, not duplicate. As S9 commented: *"The video itself was pointless, as it directly mirrored the text report."* On the contrary, some other students affirmed in the interview that they understood the value of making and learning from two types of instructional materials. S7 said *"the reports with the video worked excellently"* by complementing each other.

In summary, the above findings suggest that students tend to have more positive attitude towards the Self-Flipped teaching and learning when they fully understand the purpose of each part of the innovative pedagogy. The students who did not grasp the purpose of the video-making part of the learning activity and the course assessment (as another way to present the learning outcomes) did not appreciate the peer-produced videos as a complementary teaching resource, and also had better attitude to what was customary for them already (e.g. text reports).

B. Creating Multi-Media Materials

This sub-section presents results from the data analysis about student **attitudes to and experiences of creating multi-media materials**. We therefore answer our **RQ 1** in full here.

More than half of the interview respondents said that they never tried to create a video before this course, although S4 noted: *"I think there was at least someone in every group who had experimented with video making before"*. As a counterexample, S10 said that nobody from his group knew how to make videos, so he *"had to learn it from scratch for this course. It took one day maximum, and it might be useful in future"*. Furthermore, many of the interview participants commented that it was *easy* for their groups to create the video part of their project report and only two participants said the opposite.

On reflection, different students meant different things by calling the task "easy": for some, it meant not challenging and quick to do; for others, it meant enjoyable and appropriate for the course credit, even if it required additional time and effort. For example, S6, who said that his group spent only about 30 minutes to make the video, mentioned that for him it *"was too simple, it didn't feel like university level of assignment"* – their group's video in fact was one of the most criticised by everyone else who participated in the interviews. The video was easy to identify, as it was one of three videos that were shot outside, with a sole speaker delivering a monologue or monotonously responding to a series of questions. The peer criticism was directed not only at technical qualities or inadequate filming environment (e.g. wind interfering with the voice of the speaker), but also at the style and content of the message; being just a long monologue, the video was not easy to follow and understand for the students. Even S10, who was in the group with S6, described their video as "*boring"*.

In contrast, S7, whose video was generally referred to as the best example among the cohort, spent significantly more time on their video. This video was well made, had a very playful manner with good acting, many jokes, 'Easter eggs' (i.e. hidden messages), and, according to the majority of students, a clear message regarding the course content. S7 said they have spent *"some time"* making it:

"First, we identified the core content that we had to deliver, and then we tried to give it some form of good production around it, and then tried to have a little fun with it, so that you can actually enjoy the video at the same time as you're actually learning what we're telling you."

S7 also added that because he and his group enjoyed their time making the video, they did not feel the workload was heavy, they felt it was completely adequate for this course. Similarly, S1 commented: *"Although, the video creating added like a few hours for each person in the course, with the video editing and so forth, I think it was definitely worth it."* Several other interview participants, who, perhaps, were not as confident with video editing skills, complained that the finishing of the video took a bit too long. S8 explained: *"maybe some people will want to have a lot of time to do these movies, but I think a lot of them will not, because they don't feel like this is a part of our learning experience really"*. So, those students thought that they were spending time on unnecessary work and learning a useless skill.

One of the themes that emerged during the interviews was that the video making felt like an odd thing to do for students since many of them believed that a software engineer or an IT specialist does not have to know how to work with multi-media. S11 stated about this: *"I picture myself as a programmer in the future and I don't think I will be making movies, but maybe if you choose some other paths than that could be useful"*. In total, a third of interview participants were convinced that video making skills were not at all important for their future careers, while only two participants had the opposite opinion.

One of the most relevant aspects for the Self-Flipped Classroom approach was evaluating whether the students felt like they learned the course material while creating their videos for the course. Some interview participants explicitly stated that they believed that video making helped them to learn. For example, S1 explained:

"I think that making your video of your own subject was very good, as you had to take all this everything you learn, put everything down, and then you have to process it and make it understandable for someone who hasn't seen it before. And, at least, I learned a lot from just processing our own material."

A similar opinion came from S11, who said: *"While selecting quotes from the interviewee, re-enacting and recording them, editing and polishing the video, there was a lot of material repetition*"; this helped him to understand and remember the material very well. In the course evaluation survey, however, only three respondents said the video was valuable for their learning, while six respondents said that it did not support their learning.

One negative point of view that students expressed in the interviews was that video making was unnecessary extra work, and the material was learned through conducting the interviews and writing the text reports. *"I don't think it improved my learning in a specific way, it felt like an extra thing to do. I wanted to spend more time on the interview analysis for the written report rather than on the video making",* – explained S3. Many groups, in fact, made their videos and reports almost identical despite the instructors' idea of making them to complement each other.

Finally, when asked how their group video would compare to other group videos, only one student (S10) said in the interview: *"I didn't like our video"* and wished he saw other groups results before the submission: *"if I saw other videos, I would try to make mine better"*. A small number of interview participants felt their video was about average in the class, while the majority of respondents exhibited feelings of satisfaction and even pride for their creations. S2 said: *"I thought the video that we made was super-good!"*; S12 said: *"We did a great job!"*; and S7 added: *"I think ours was much more entertaining. It was enjoyable and fun to watch our video"*. Interestingly, even S9, who said the video part of work was pointless, commented: *"I think we did fairly well. We didn't do anything silly, but we were creative [TV anchor interviewing a reporter], and you could get the information we wanted to deliver straight away"*. This confirms that a majority of the interview participants not only positively accepted the idea of video making for their assessment, but also enjoyed the video-making process and the end results of their work.

To answer the research question **RQ 1**, we summarise the main findings below:

- Creating video artefacts was not something the students in this study were accustomed to and knew how to do. Only a minority of the students had previous video making experience.
- Nevertheless, the majority of the students thought the video making task was not difficult, and the absence of previous experience did not put them off. Only a few of the interviewees complained about the time they had spent on video editing.
- Most of the student were happy with their final artefacts.
- The majority of the students did not believe the skill of video making would become useful in their future career. Furthermore, many of them did not understand the how video making could help them to learn the course material.

C. Learning from Materials Created by Peer Students

This sub-section answers the **RQ 2** by presenting results from the data analysis about student **attitudes to and experiences of learning from materials created by other students**. The aspect of learning from student-created materials can be explored from two perspectives:

- learning from videos vs learning from texts;
- learning from peer-produced materials vs learning from instructor-produced materials.

The video versus text preference reflected the fact that different people prefer different learning media and styles. Nearly half of the students said in the interviews that they preferred to learn from videos: *"I think, I'm more visual. So, for me, it's always easier to watch a film than read a report",* said S12. On the other hand, a few respondents said the opposite: *"So, like you could just read report and then like skim through the video because it was faster to read a report than watch the video",* said S11. At the same time, some interview participants highlighted the fact that videos were good for getting an overview of the presented information quickly and easily while the reports were good to explore and understand the issue in details. S3 elaborated that:

"It was sort of a quantity vs quality thing. The reports were much better to read to completely understand the situation. While, watching a video was so quick and easy that you could watch several of them and realise 'oh, this is a problem in both this case and that case, and that case too, so it's probably important'. But the specifics of the problems and the way to solve them in various ways were more a report thing."

This suggests that at least some of the students understood that a video and a written report were meant to supplement each other by delivering the materials in two different formats. Students who shared this opinion added that videos were very helpful when they gave something new, for example, showing the context or environment of the reported issue. However, not every student group was successful in understanding the point of creating two different formats of the report, so "*some videos weren't as helpful as others"* because they just directly repeated the text reports (S7).

Traditional education, especially in STEM subjects, usually helps students to learn how to read and write texts rather than to create meaningful multi-media messages. As S9

commented: *"We have written zillions of reports, so we know how to deliver a message through text"*. This was, perhaps, one of the reasons why in some student groups the text part of the projects was better than the video part. When asked if it was easier or harder to learn from videos, several interview respondents stated that a few videos were more difficult to understand than their corresponding text reports. S1 commented: *"[learning] was pretty hard from some videos because it felt like some groups hadn't grasped the purpose of the video, that the videos were actually supposed to teach something",* while few other interviewees did not see any issues with learning from the videos: S4, for instance, *"didn't feel a need to read the report or anything else"* after he watched the videos. Bearing in mind that some of the videos, in fact, were not made to a satisfactory level of content quality (those groups had to do an additional assignment to pass the coursework, but there was no time for them to redo the videos before they were shared with other students), this suggests that students like S4 were not critical enough when watching and learning from student-made materials. Fortunately, at least some students who participated in the research interviews saw the problem with the content quality in those videos. S2 for example, said that some videos did not deliver the necessary information. S7 added that: "*some videos were pretty basic in what they were talking about, and at the same time, they were very boring videos."*

In general, the interview respondents indicated that the quality of the student videos was about "50/50", with some very good videos and quite bad ones too. Student responses in the course evaluation survey supported these results. The multiple-choice question about peer-produced videos received an equal number of responses (n=5) to the statements: *"taught me a lot about the course topic"* and *"did not teach me as much as I had expected about the course topic"*.

It is important to emphasise that videos were judged as poor not due to their technical qualities or videography. When asked whether any technical flaws in the videos had negative impact on learning from them, S2 clarified:

"I think it's not the video quality, it's the message, and also we have come to a thing that, it doesn't have to be like a super 1080 pixel or anything, it's like a normal video quality would do for learning from it."

A few students commented in the interviews that one of the videos *"was acceptable, but it wasn't that good"* (S1), and that its audio quality was poor due to wind interference, while all other videos *"were just fine"* (S9), and their *"quality was pretty OK. So, technically, I would say, I didn't need to watch the videos again"* (S2). In total, most of the students in the interview said that all of the groups met at least the baseline on the technical level of video quality. This was also supported by the course evaluation where more respondents said the videos *"were an accessible course material"* than those who said the videos *"were hard to understand"*.

Overall, with an exception of S9, all interview participants in one way or another indicated that learning from the peer-produced videos was an interesting and enjoyable experience. In the course evaluation survey, seven of the 14 respondents stated that the videos "*were a fun course material*" while only three disagreed by choosing to say: *"I did not enjoy this way of learning about the course topic"*. These results suggest that with an exception of a small number (1-3) of cases, the student-produced videos were a useful and enjoyable teaching resource. The students who usually prefer learning from visual sources of information highly appreciated them.

The question of whether the students would prefer the videos in this course to be made by their instructors or other external experts was closely related to the general attitude towards peer-learning. Here the interview participants provided a few interesting insights. On the one hand, all of the interviewees presumed that the instructor-made videos would be of higher quality: they would be more instructional and *"more to the point"* (S11) which is *"mainly because instructors tend to care more about what they produce"* (S3). Yet, interestingly, it was rare for the students to say that they would actually prefer instructor-produced materials to peer-produced ones. Furthermore, more than a half of interview respondents said that it would make no sense in this particular teaching and learning model. For example, S7 suggested that:

"*If the instructor made the videos, they would not be part of the dynamic of peer-learning, the discussions around the videos would be very different… I mean, the learning would be more like 'absorbing information' rather than 'critically, actively developing an understanding'."*

Moreover, as noted by S10, even if the instructor-produced videos were perfect in terms of quality and content, *"it is better to watch the student-made videos, as it's more interesting, more fun. Because we are learning together, we are doing some things together, so I'm looking at their efforts, they are looking at mine and it helps me to learn"*. These observations suggest that the students in fact appreciated the peer-learning concept of the Self-Flipped Classroom approach.

The students also explicitly expressed their preference to their classmates as the video authors, stating that if the videos were made by other, non-familiar, students, the motivation and enjoyment to watch the videos would have been lower. S8 elaborated:

"I enjoyed watching the people I knew in the videos because I thought that was funny. It's not going to be funny anymore when I look at people I don't know… So, that will give a different aura on the whole thing because then you aren't as focussed since you don't really care if you see everybody's videos. But if you know the people, you will actually want to watch every single one of them because you want to look at their faces and their work and everything."

In addition, S8 and S11 expressed a similar opinion that instructor-produced videos would be significantly less interesting to learn from: firstly, because they would likely be more serious, and secondly, because that would be just one person presenting the information, and thus the facts might blend together. S12 added to this: *"I think what made a difference was that it was funny to see your classmates doing something different and portraying it in a very specific way"*. According to these respondents, every group of students gave a different perspective to the topic they reported about, and watching 12 videos presenting a lot of different perspectives was perceived to have worked much better compared to watching 12 very similar videos.

The students have also highly appreciated the peer-learning approach based on constructive controversy and affinity diagram techniques. Many of the interview respondents provided comments similar to those by S4 who said:

"*I liked the fact that each group covered a piece of a matrix. It was interesting to see how our work fits into the matrix, also was interesting to see what was different and what was similar in different organisational contexts.*"

Only S5 noted a downside of such approach, saying:

"One of the problems with this method of learning, is that the students are collecting and presenting the information. If they miss something then the rest of the class will miss it as well. But it's a good way to collect a lot of information."

Majority interview respondents said that it was great for them to learn from materials produced by their classmates. S4, for instance, stated:

"I appreciate the concept of making your own video and then watching everyone's else. I guess, you could relate more on what they were trying to do, when they are your fellow student, because you know the authors, and you did the same work. I was always interested to see what others found as most interesting to present in their video, somehow comparing their content to our video".

Finally, one of the most interesting aspects of learning from peer-produced materials was the trust that the learners had for the information delivered in such materials. In contrast to relevant literature, e.g. [20], and to the instructors' intuition prior to the course, the large majority of students, said in the interview that they had no doubts at all when learning from the peer-made reports. As S11, for example, said: *"I trusted my other students that they delivered information from the interview, what their interviewee has said. I trusted that it would be correct".* The students knew, that all the materials were checked by the instructors before being shared with the class, and so S8 said that if the instructor "*looked at them as well, I think, that hopefully it was pretty correct"*. However, a few of interviewees made comments about opinions and interpretations of the information. In particular, S3 reported:

"In the absolute majority of cases, I trusted my classmates. I don't think they would lie, that's never. But in some of the videos there were some things that are more prone to interpretation, such things might have been misinterpreted."

S7 made an interesting remark when hypothesising if the videos were made by the instructor:

"Of course, looking through those videos people wouldn't have any doubts about 'this is my definition' people would be like 'OK, that's the definition, I'm incorrect'. There would be more of that kind of thing but with peer-to-peer it kind of opens up more of a discussion. Because then you are kind of like 'OK, wait, so this is my definition, this is your definition, why is this different?'".

This suggests that the students had no or little doubts when learning factual information from peer-produced materials and did not question why those materials were not made by the instructor. Moreover, watching peer-made videos actually stimulated more thinking and more reflection in the students than it would have been with all of the resources made by instructors.

To answer **RQ 2**, the students **accepted** the materials created by their peers as trustworthy and suitable for learning. Most of the students engaged in critical analysis of the videos produced by their peers (by evaluating their quality and/or by questioning the presented information), without realising that this was part of their learning. Student **experience** of learning from these materials was generally positive, although it is worth noting that traditional focus on producing text reports meant that students were not experienced in producing videos, and some students questioned the need for learning from videos in addition to learning from more familiar text reports.

D. Instructor Attitudes and Experiences

To answer the **RQ 3** about the instructor attitudes to and experiences of the SFC, we decompose the **attitude aspect** into initial motivation and post-evaluation or reflection. The **experience aspect** can then be covered by a description of the instructor activities during the course, as well as the challenges they encountered. We base the analysis on the interviews with the course instructors, focusing on three main themes of the interviews: motivation, experiences, and the perceived outcomes.

We start by discussing the motivation of the instructors who decided to introduce the Self-Flipped Classroom approach into their teaching. Both the course leader (CL) and the teaching assistant (TA) of the "Complex IT systems in large organisations" were intrinsically motivated to try the SFC approach in their practice. The course leader tends to organise all her courses around student-centred active learning. Thus, she designed the new course with the idea of student artefacts reuse in its core.

The TA also saw a great value of the approach for their students: *"I personally think that it's good that they actually learn to do things like that [creation of instructional materials]. That they get out of their comfort zone and that they learn to reflect on what they see and do in that way."*

The attitude of the instructors towards the Self-Flipped teaching and learning method stayed positive from the very beginning to the end of the course. Despite the challenges in running such an innovative course, the team continued using the same approach in the next iteration of the course. CL said: *"It's much more motivating. I'm also very convinced they learn more."* Both instructors were confident that the students learn better in the SFC model, and that the "love it or hate it" attitude of the students could be avoided by better preparing them to the unusual structure of the course, and explaining its rationale and benefits.

To address the second part of the **RQ 3**, which relates to the **experiences** of the instructors, we review the challenges that were triggered by the SFC.

The biggest challenge from the point of view of the instructors was that they had no control over the quality of teaching materials. Since each student group has been assigned to cover a specific phase of IT system life cycle in a specific context, the instructors had to include all of the videos and reports into class discussion and exam preparations, even when some of them fail to be of good quality. The course timetable was tight and there was no time to ask students to redo the videos. This echoes the instructors' challenge when teaching using student-generated materials outlined earlier by Miño-Puigcercós et al [21]. As CL explained:

"We had a situation where we did not pass a few students [for the group project report]. And in the end, we decided not to let them redo the film because there was no time really. So, we made them reflect on what they should have done better and hand that in. Because otherwise there would be a hole in the matrix of what they did. No student did the same film as

another student, so all the films were needed to get the full picture. Which was good because that's very motivating but when they failed, we had a problem."

Both of the instructions were worried that a portion of the teaching material that had to be released to the students was not of good quality. This subsequently negatively affected learning experiences of students who saw that the material was not perfect, resulting in a large portion of negative feedback.

Another challenge that put constraints on how the SFC could be implemented was that of ethics. When it concerns students, universities have very strict regulations on what could be released. For example, the instructors could not reveal which videos were below the necessary level of quality to the rest of the class. CL explained: *"We could not tell the other students about the videos that did not pass, because we can't disclose that kind of information about students"*.

Furthermore, if the instructors decided to reuse the videos from one cohort to another, the videos would need to be "approved" and consent obtained from the authors, making it difficult to accumulate a library of high-quality student materials. Ethics aside, there is also a clear trade-off: by reusing videos from last year, one could improve their overall quality but at the cost of losing the personal connection between the students and the video creators. If the students do not know the creator (another student) then they might start asking why the instructors did not make the video themselves.

As has been mentioned in the student attitude part (Section V, sub-section A), with the course being too different from what the students were used to, some of them were sceptical about the new way of learning. Referring to the polarised course evaluation results, the TA commented:

"I don't think that the students necessarily saw it [the value of SFC] because we put some more constraints and some more work on them and I think that they might see that work as irrelevant to the topic, right? Like 'we didn't take that course to learn how to do videos' for example."

The instructors reflected that they needed to stimulate student thinking about what and why they were doing as part of the course assignment, which was especially important when students were asked to do non-traditional coursework, such as interviews and videos. The instructors agreed that needed to be more prescriptive and give more directions to stimulate the intended learning process, as explained by TA:

"[To improve next time] to give clearer instructions. I think also really ask them to talk about their experience and not just using bits and putting them together so that you have the length of the video required right. So then definitely require that background work, so that they actually have to process something, when doing the video."

The "hate" part of the cohort requires an extra effort of selling the idea, to ensure that students are motivated to produce good quality materials for the sake of their learning, as well as the learning of others.

VI. Summary and Conclution

The main outcomes from this study are as follows:

a) Student perspective

As many new ideas, the SFC approach received a mixed response from the students. Due to the lack of previous experience with such forms of teaching, the students were generally not ready for active learning methods involving video content creation. This led to the "love it or hate it" split within the observed cohort. Students who appreciated the SFC, enjoyed the course and learned better through the creation of good quality materials, which further engaged and inspired their peers. On the other hand, the students who did not understand the purpose of the SFC or did not like its form, created poor quality materials, which negatively affected the learning of their peers, and also attracted criticism of the whole cohort, i.e. from both sides of the split.

b) Instructor perspective

While the instructing team was convinced of the benefits of the SFC and planned to continue using it in future iterations of the course, they were faced with a number of challenges. Their overall impression after running the first iteration of the course was that their aspirations and goals for quality active learning were not fully fulfilled, and their efforts to prepare and scaffold the students did no fully pay off. They found it difficult to provide the right level of scaffolding for all of the students and to ensure the high quality of student-created materials without being too prescriptive. This led to the abovementioned "love it or hate it" split within the cohort.

There were also some challenges that can be addressed by technological and administrative innovations, specifically: (i) technical issues of producing, sharing, storing and archiving student created video content (these have to support large file sizes and be secure), and (ii) ethical considerations and processes that need to be put in place to manage student privacy, especially when students appear in videos, intellectual property and the reuse of the created artefacts, as well as non-disclosure of assessment results.

c) Overall perspective

By combining video creation with traditional text reports, the instructing team successfully accommodated for different learning styles and preferences. Moreover, the SFC allowed the whole student cohort to benefit from personal connection between students-as-creators and students-as-learners, which led to their increased motivation and engagement, as well as critical evaluation of the created materials.

To sum up, this study shows that introducing new learning methods in computing can be challenging, and students do not always appreciate innovative methods despite them being based on research in teaching and learning. Instructors who intend to try similar pedagogies in CS have to think carefully on how to convey to the students the value of being more than just a programmer and a consumer of information delivered by the instructor. They also have to explain how the proposed innovative teaching could help CS students to succeed in future. Computing science students tend to have a limited view on what it takes to be a successful CS/IT professional and most of the time they do not like to come out of their comfort zone.

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