Biology Meets Mechatronics (BIOMEETSMEX)
Video Reporting for Development of Project Management and Interdisciplinarity Skills

Tino Koponen[1], Tommi Lintilä[2], Anton Vanamo[1] Ara Taalas[1], Heli Viskari[1], Katrina Nordström[1], Panu Kiviluoma[2] and Ari Ora[2]

[1]*Department of Bioproducts and Biosystems, Aalto University School of Chemical Engineering, Kemistintie 1, Espoo, Finland*

[2]*Department of Mechanical Engineering, Aalto University School of Engineering, Otakaari 4, Espoo, Finland*

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Abstract: A pilot project BIOMEETSMEX, combines two engineering schools to support the development of co-creative means of project and product presentation, interdisciplinary and problem-solving skills. The aim was to expand students' ability to communicate scientific data through self-produced videos rather than written media, and to offer motivating and informative ways to learn scientific concepts and for teachers to assess learning. A "library" for learning could be developed, to allow for other students to access student self-produced videos in future courses.

1 INTRODUCTION

Societies are rapidly changing from being local to global with a working culture in which data flow is continuous. Such a working culture has enforced a paradigm change for educational systems, especially for developing flexible and rapidly adaptable approaches for supporting deep learning and cognitive capacity of students (Sweller et al., 1998). In parallel, rapid advances in science calls for interdisciplinary problem-solving ability, for unraveling current and emerging societal challenges (Gero, 2017). Interdisciplinary problem solving increases innovation and supports students to more smoothly adapt into post-graduation working life where multidimensional and disorganized problems are typical. Accordingly, educational systems strive to support students to develop their capacity to engage in interdisciplinary thinking, collaboration, and problem- solving as well as rapidly responding to the vibrant society in the digital world (Klein & Falk-Krzesinski, 2017).

Digitalization and robotics are changing the way societies function and data can be compiled to different platforms and distributed via tablets, virtual learning environments, mobile devices etc. to groups and individuals (Manfra & Hammond, 2008; Gillie et al. 2017). This highlights the importance of multidisciplinary teamwork in a space and time independent manner (Smyth, 2011). In addition, emerging new approaches use social media channels in teaching such as Facebook, YouTube, Blogs or bots (Tess, 2013). This also makes it possible to digitalize teaching material in a cost-effective way for larger external audiences. Moreover, such material is familiar to students and has great significance in supporting lifelong learning and also offers equal opportunities for learning for disabled students (Gillie et al., 2017).

Smyth (2011) has created a model to distinguish between learner-content and learner-learner interactivity in learning design. The model promotes important views into the need for developing more conceptualized interactive learner spaces, which are less constricted by the technologies that are used to support them. These are akin to virtual environments, such as Second Life (Kangasniemi et al., 2014, Qvist et. al., 2015) where interaction mimics a face-to-face environment and where, according to Smyth (2011) " *'community' becomes embedded as pedagogy*."

Regardless of the rapid introduction of digital teaching resources, there has been limited research

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into how students use such resources (Gillie et al. 2017). As reviewed by Gillie et al. (2017) Saunders at Hutt (2014) have defined rich-media as *"Pre-prepared videos, audios and images (still and animated), which are created for the purposes of teaching and learning* ". In a study on three rich - media teaching resources, namely lecture podcasts, key-concept videos and tutorial videos, Gillie et al. (2017) concluded that engineering undergraduates find short, focused resources most useful, and also add that non-native English speakers and students with disabilities find these resources particularly useful. Retention rapidly reduces if the length of the video exceeds five minutes (Gillie et al. 2017).

The use of videos, podcasts, vodcasts, lecture – capture (audio only, audio only or video only), use of narrated power points and numerous other digitalized approaches are already firmly established as part of higher education and will most likely continue to develop in accessibility and ease of use (Copley, 2007; Parson et al., 2009; Gillie et al., 2017). There has been some concern that student-teacher interactions may diminish, however, these rich-media are usually part of blended learning approaches, and not intended to replace traditional face-to-face interactions by students and teachers (Martinez-Caro & Campuzano- Bolarin, 2011; Gillie et al., 2017). A typical feature for all of these approaches is also that they are not tightly standardized, rather there is a lot of variation in the purpose (eg. assignment preparation, revision materials, distribution of class information etc.), in the preference of students for different types of media, as well as the perceptions of students and teachers on how these enhance learning or support development of skills (Saunders & Hutt, 2014; Gillie et al., 2017).

However, there is also interest in the use of student self-produced videos in teaching and learning. Young people today are active producers of video-clips and other digitalized material with content, distributed often by smartphones, blogs, or social networks (Corten-Gualtieri et al. 2015). Moreover, they are used to spending a lot of time watching movies, soaps and other audiovisual content, which has lead Corten-Gualtieri et al. (2015) to study if and how student produced video clips could enhance student learning. In their study on how to promote the concept of Newtonian physics, students created video clips in which the evaluators and peer students considered the scientific content to be interesting and the activities required a genuine cognitive effect from students. Namely, students needed to question, analyze, search for information, manage socio-cognitive conflicts in their groups and reorganize their conceptual paradigm (Corten – Gualtieri, et al. 2015).

The conceptual paradigm of students can, however, not be challenged or reorganized by the students, in a vacuum setting, such as the lecture room or the laboratory. Rather, advances in science have wide social implications and videos produced by students should be anchored into real life (Willmott 2014; Corten-Gualtieri et al., 2017). This is particularly relevant to engineering and biosciences, which have also deep social implications to the wider community. Willmott et al. (2014) used student-generated videos for the teaching of bioethics, and concluded that students not only learned about the core issues, but that the materials could also be used to enhance the public understanding of the science and ethics relating to biomedical innovations. Benefits of the videos to the students were 1) students had the opportunity to demonstrate their creativity, 2) genuine teamwork was required, 3) argumentation and storytelling skills were promoted, 4) students were exposed to software and other multimedia tools, which have generic value also for the development of future professional skills. Wilmott (2014) therefore concluded that all of these are benefits, which enhance the employability of the students in the future.

Our university was founded in 2010 as a merger of the leading universities of engineering & science, business and art, in order to create a new concept of an innovative and interdisciplinary university. Consequently, our mission is to educate game-changers, to break disciplinary borders and to implement novel teaching and learning approaches into education. As of 2016 onwards the University has funded some 100 different learning and teaching development projects, which start as pilots and if successful, become adopted into the curriculum. This initiative is administered by a coordination group, which also is responsible for arranging regular meetings between all piloting groups, as well as providing technical and pedagogical support all through the piloting phase as well as afterwards. The idea of the pilots fits into the educational design thinking practices. Even though there is no clear classification of design thinking as reviewed by Johansson-Sköldberg, et al. (2013), it provides a very practical approach and aims to experiment, analyze and put new approaches into practice after iteration. Accordingly, experimentation within the pilots aims at practical outcomes that can be included into curriculum development and not on extensive theorizing and researching.

In this study, we describe one such pilot, Biology Meets Mechatronics (BIOMEETSMEX) for which planning started in 2016 and piloting took place in the spring of 2017. Namely, we investigated how Master-level engineering students from Biotechnology, Biosystems and Mechatronics majors were able to apply their social, video reporting, project management, and interdisciplinary skills to achieve a shared goal of constructing a Rotary Wall Vessel (RWV) bioreactor. The BIOMEETSMEX pilot aimed to achieve three educational objectives. First, the aim was to deepen the students' understanding, applying and problem-solving skills on different levels of interdisciplinary collaboration. Second, the pilot aimed at providing practical insights into how to make a product in the real environment. Third, the aim was to expand the students' ability to communicate scientific data through other than written media, and to offer this also as a less time-consuming and more informative way for teachers' to assess learning. Moreover, a more empirical aim was to develop a "library" for learning. Such videos could be used in the following years to show students what others have done and to learn from these experiences. However, many technical and legal issues need still to be resolved, and therefore the present communication will only present some general views on such a repository.

2 BIOMEETSMEX

The School of Engineering (ENG) of the University has arranged a Master-level Mechatronics Project (MP) course for more 20 years. The goal of the course has been to encourage and assist students in conducting their own project that aims to produce a self-built and designed physical mechatronic machine or other apparatus over a period of two to three months. Simultaneously during the spring term, the School of Chemical Engineering (CHEM) of the University has arranged a Cell and Tissue Engineering (CTE) course, which had been held twice before the collaboration described in this article.

The CTE course formed the basis of the BIOMEETSMEX pilot, as the university renewed all M.Sc. programs during 2015-2017. The CHEM school completed the new structure in 2016, but curriculum change was implemented at the ENG school 2016-2017. To avoid possible work overload for the MP course teachers at this transition phase, the CTE was the main platform for the piloting.

2.1 Background

The CTE course is an elective course in the Biotechnology M.Sc. and the Biosystems and Biomaterials Engineering M.Sc. majors. The number of students that are accepted to the course is restricted to 25, as the cell and tissue laboratory work and the electrospinning requires very specialized laboratory space, technical help and expensive materials. The course is equivalent to 5 ECTS and runs over a period of 12 weeks from January to April. The total amount of student work for the course is 135 hours. According to the University requirements 1 ECTS is equivalent to 27 hours of students work. The CTE course has been defined in the curriculum as containing project work on given assignments (50h), final presentations (4h), exam (4h) and independent studying (77h). Independent studying is categorized as reading materials, meeting with group members, studying for the exam and producing written reports, however, this also overlaps into the hours allocated to project work. At our University all course requirements are posted on the MyCourses learning platform so that students can make prior estimates of the workload and the requirements of the course. A total of 22 students enrolled to the course, of which five students from the Biosystems and Biomaterials Engineering major, could not attend the laboratory part of the course due to other overlapping compulsory courses. This major is a new initiative and offered by the Life Sciences M.Sc. major and coordinated jointly by several of the schools in the university, which still causes some problems in scheduling. Consequently, these students completed the course by a written project on a chosen topic in cell and tissue engineering products. They formed an independent part of the CTE course, and were not included in the video production, due to their timetables. Therefore a total of 17 students participated in the BIOMEETSMEX pilot as described in this communication. The CTE course in 2017 included a series of collaboration-supporting lectures focusing on the scientific issues within bioreactors, cell-extracellular matrix interactions, and functional tissues. The project work included the work in the laboratory and the production of the videos.

The M.Sc. level MP course is a 5-10 ECTS course for 6 to 12 weeks, which students can complete according to their own choice in the longer or the shorter format. However, for the purposes of the BIOMEETSMEX the focus was on the 5 ECTS completion, to match the CTE course ECTS's. The regular MP course consisted of completion of a student project in groups (usually 4-7), with projects mostly in the areas of robotics, sensors, instrumentation, as well as large mechatronics process equipment for industry and in collaboration with industry. The regular MP course is an elective course for the study path in Mechatronics in the M.Sc. program of Mechanical Engineering. There is no maximum limit to participants, and the estimated average number of students taking the course is about 70. The MP projects require a literature survey and report, which are written as scientific articles. However, for the purposes of the present BIOMEETSMEX pilot, the collaboration and the focus of the groups was on the mechanical aspects of constructing a Rotary Wall Vessel (RWV) bioreactor, project management, and presentation via videos (Figure 1). As the 4 students from the MECH major had already chosen to to participate in BIOMEETSMEX during their enrolment to the MP course, they formed their own group. The possibility to choose different project is posted some 2 months prior to the start of the MP and and thus these students self-selected to participate in the BIOMEETSMEX pilot.

2.2 Practical Implementation

The BIOMEETSMEX was organized as follows. Seventeen students from the CTE course formed four groups (hereafter BIO groups) and four students from the MP course formed one group (hereafter the MECH group). The CTE participants formed groups at random, ie. they could form their groups freely to include 4-5- members. We have experimented for many years and on many courses on the optimum group formation, however, we have come to the conclusion that at the M.Sc. level, our students prefer to make their own choices. The arguments for and against this decision are deliberated on in the discussion of the present communication. The MECH group members also took part in each of the BIO groups as mechatronics consultants in order to assist the co-working between biotechnology and mechatronics students. In addition, two teaching assistants of the CTE course helped to organize the collaboration practicalities throughout the course in order to facilitate the working of different groups. The overall timeline of the collaboration is presented in Figure 1.

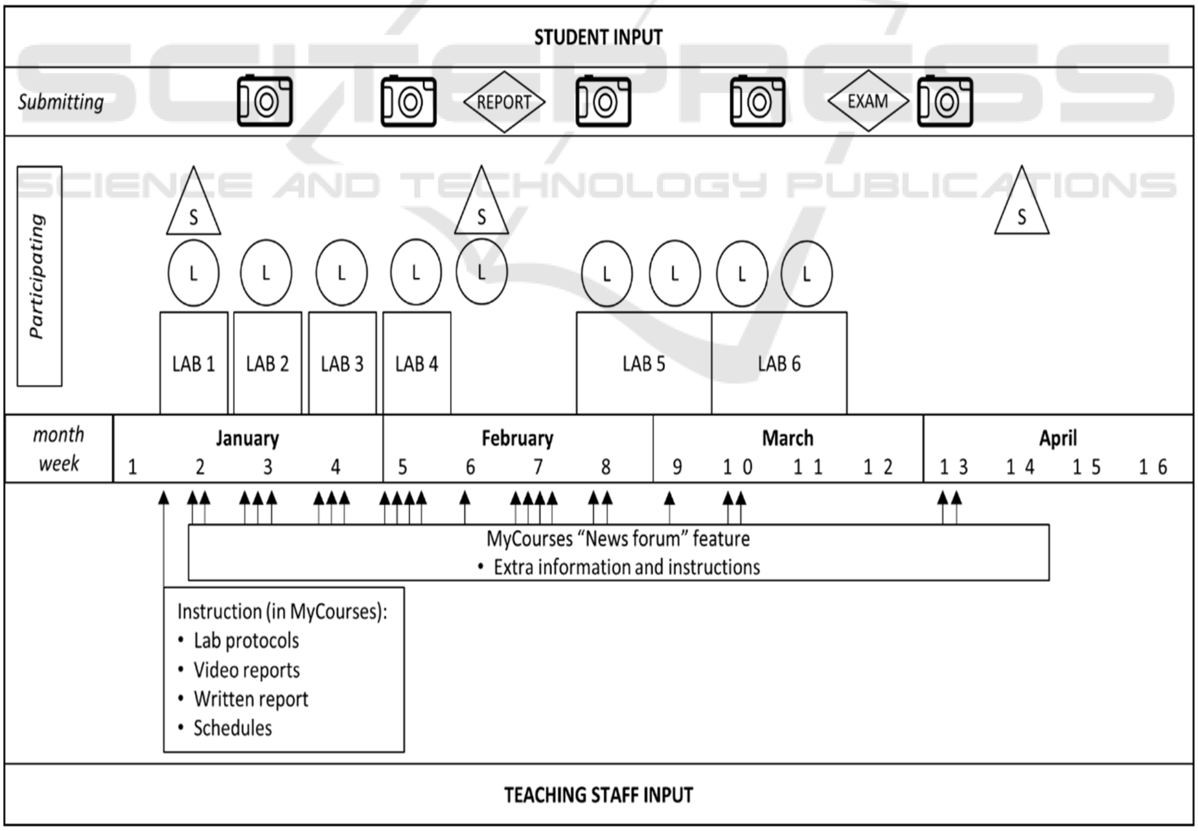

Figure 1: The timeline and the student/teaching staff inputs on the CTE course. L stands for CTE lectures, S stands for session working, Report refers to the RCCS report that the BIO students produced and Exam refers to the open book exam in the CTE course. The camera icon indicates the deadline for a video report.

BIO and MECH groups had both independent and shared assignments during the collaboration. The BIO groups were instructed to familiarize themselves with the commercial RWV bioreactor type called Rotary Cell Culture System (RCCS). The BIO groups also acted as consultants for the monitoring of either pH, oxygen, carbon dioxide or cell amount for the RWV bioreactor that the MECH-group assembled. In addition, the BIO groups participated in six different laboratory exercises in order to learn the main techniques that are required in tissue engineering and that affect how the RWV bioreactor is used. The BIO students also needed to take an open book exam at the end of the course. The MECH group was to build by themselves the RWV bioreactor. The main shared assignment was video reporting.

2.2.1 Student Collaboration

Together with the MECH consultant, each of the BIO groups were to produce five video reports throughout the collaboration. The video reports required the students to reflect on the laboratory exercises, the group working, the bioreactor building and the project proceeding. The videos were to be about 5 to 10 minutes long and constructed in a free form as long as they discussed the project work. Video reporting is presented in more detail in section 2.2.2. The BIO and MECH groups also constructed a shared interdisciplinary dictionary and were to interact with each other over the bioreactor-design-related questions. The MECH students were also encouraged to participate in the laboratory exercises and the lectures. The teaching assistants were in charge of the laboratory exercises, produced all of the material and information that was given to the students at the beginning of the collaboration, and messaged additional information throughout the course via the News forum feature on the University MyCourses online teaching platform, which is similar to the Moodle platform. MyCourses was also used extensively over the course as one goal of the collaboration was to conduct the majority of the content online.

Since the BIO groups carried out the laboratory exercises mainly independently and the MECH group was physically working on the other side of the campus, so-called session working was utilized to enhance co-working. Three sessions (introductory, middle and conclusive session) were arranged so that all of the groups came together to conclude the collaboration so far. The sessions paced the collaboration and served as landmarks during the fourteen-week-long collaboration. The project goal, assignments, and timeline were introduced in the first session so that the students could easily adjust to work within the project and to assimilate bioreactor requirements.

One important emphasis of the first session was also to get the group members to know each other. The students were also required to schedule their laboratory exercise times during the first meeting and agree on practicalities such as the person responsible for handing in each of the assignments. The second session was the first deadline for the MECH group and they presented their building and design plans for the first RWV bioreactor model (called Bioreactor 1.0 in Figure 2).

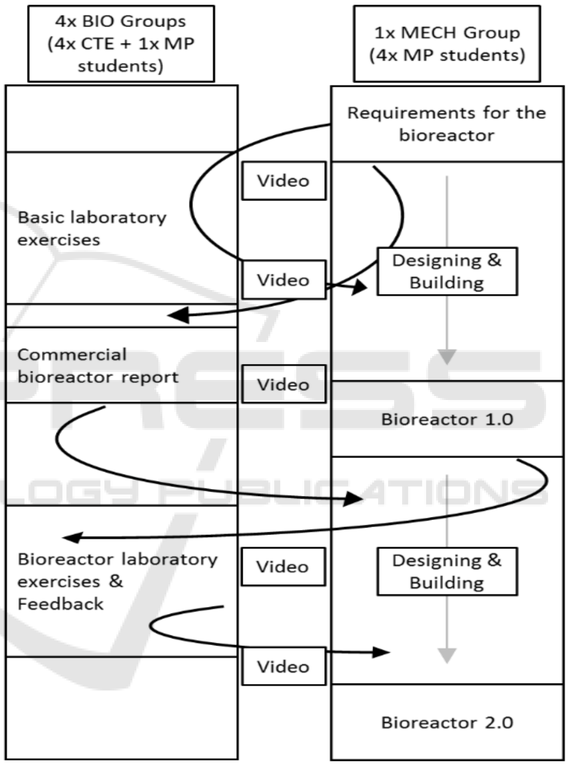

Figure 2: Flow chart of the collaboration.

As the BIO groups simultaneously were to hand in their written RCCS reports thus knowing the commercial model features, the RWV features were discussed and some modification done according to the session-derived ideas. After the second session, the MECH group finished building the first RWV bioreactor model and the BIO groups used this model in their following bioreactor laboratory exercises. Based on the hands-on user experience, the BIO groups gave feedback to the MECH group that then utilized these ideas to develop and produce a second, improved model of the RWV bioreactor (Bioreactor

2.0 in Figure 2). The third conclusive session was held alongside the Mechatronics Circus, which is an annual gala at the School of Engineering to showcase the MP course outcomes for other students, University staff and industrial partners. The third session was also a possibility for the BIO groups to see the improved RWV bioreactor and thus it served a collaboration-concluding event.

2.2.2 Video Reporting

For the video presentations students were required to reflect on their own learning. Namely, the goal of the video reports was to describe how the project is proceeding and what the group has done so far. The students were instructed to focus on explaining the work through the scientific context. The exact content was rather free as long as the instructions below were used as a guideline. Format-wise any of the following suggestions could be used, or students could come up with their own format. Also it was up to the students to choose the software and equipment they wished to use. The instructions were as follows: 1) Students may produce a compilation of short video clips or pictures merged together for example with Windows Movie Maker (available on school computers) or equivalent. These clips could be from laboratory exercises, lectures, meetings with the group etc. Snapchatty or GoPro-like material, however, some sort of a guiding idea is necessary throughout the video, 2) the groups were required to have a meeting, make some plans on what they were going to discuss, press play and talk about the project – simple, efficient and no editing needed. Students were instructed to make sure that they do have some plan for the discussion so that it makes sense and it covers everything needed, 3) students were also instructed to think about the visual impression, as these are videos, not just an audio (a group of people sitting and talking for 5 minutes might be boring), 4) a short lecture on the project with focus on the scientific aspects. The University provides two programs (Panopto and Adobe Connect) to record a lecture with power point slides on it. If students felt that these programs are beneficial they were also allowed to use them.

The above points were, however, only suggestions so students were encouraged to feel free to let out their inner movie director (a movie, a play, a TED Talk, an interview, a cartoon, drones, selfie sticks, car chases, non-life-threating explosions etc.) – they were also told not to get stressed out about this (a simple video would be completely fine). The requirement was that every member of the group must be seen to be part of the production. For content the following instructions were given, with emphasis on giving scientific explanations to the issues that are presented in the video:

1) What (interdisciplinary) have we done in the project so far?
2) What have we managed to do well?
3) What has caused challenges?
4) What are we going to do next?

Moreover, students were required to answer these video-specific questions:

Video 1 (Week 3): Did Session 1 after the first lecture help you to form a group?

Video 2 (Week 5): How is the building process of the bioreactor proceeding?

Video 3 (Week 7): Discuss the reflective questionnaire that you have been asked to fill in on a) your personal social interactions within the group and your perception of your own role, and b) the functioning of the group as a team.

Video 4 (Week 10 or 11): Development ideas for the bioreactor. Praise all team members for something they have done.

Video 5 (Week 13): Conclude all that you have done during the project: what did you learn? Also comment on the online resources you were given and that you used: did you find them useful?

3 OUTCOME AND DISCUSSION

The outcome of the study will be discussed in the context of the video reports and the survey questions that were the theme for video 3, as presented above in section 2.2.2.

All groups provided the required videos on time and the video reporting was very popular with the students. On the other hand, it was evident, that of the four groups, two were able to focus on the scientific aspects of their work, whereas the other two groups were presenting more of an iteration of what they had done in the laboratory, similar to a laboratory logbook, without deeper analysis. These findings are very similar to Corten – Gualtieri et al. (2017).

The two more successful groups produced very professional presentations from a scientific point of view, and were able to explain the scientific reasons as to why they had made certain choices, what had worked and why. They also were able to analyse their own results and to give very logical suggestions to the future trends of the work, if it were to be continued. The reason for this difference between the two groups

Table 1: Student survey in connection with video reporting 3 (see 2.2.2) on student's personal role as part of the group (compl. = completely, Tot = total, Av. = Average).

Student	Agree fully	Agree	Neither	Disagree	Disagree fully	Tot	Av
I can be myself	11	5	0	1	0	17	1,47
I can express my opinions	13	4	0	0	0	17	1,24
I focus on the subject in the meetings	9	8	0	0	0	17	1,47
I am genuinely present at the meetings	10	7	0	0	0	17	1,41
I listen to other team members without prejudice	13	4	0	0	0	17	1,24
I encourage others to speak	7	6	3	1	0	17	1,88
I observe, how others react to my opinions	6	7	3	1	0	17	1,94
I diminish my thoughts and feelings	0	3	3	7	4	17	3,71
I feel a need to explain my behavior	1	9	6	0	1	17	2,47
I undervalue myself	0	0	5	8	4	17	3,94
I give in to others	0	2	7	8	0	17	3,35
I'm not satisfied with my team	0	1	1	6	9	17	4,35

Table 2: Student survey in connection with Video reporting 3 (see 2.2.2) on functioning of the groups as a team group (compl. = completely, Tot = total, Av. = Average).

Student	Agree fully	Agree	Neither	Disagree	Disagree fully	Tot.	Av.
Team members are not afraid to express opinions	10	6	1	0	0	17	1,47
Opinions are well argumented	5	12	0	0	0	17	1,71
Team aims to solve problems	10	7	0	0	0	17	1,41
Responsibilities are shared equally	6	10	1	0	0	17	1,71
Team has common goal	10	5	2	0	0	17	1,53
Team has clear roles	5	4	7	1	0	17	2,24
Team has clear schedule	5	10	0	2	0	17	1,94

could not be explained by the group dynamics, because the survey on the roles of the students as individuals within the group and the functioning of the team as a group, was overall very positive. Table 1 shows the responses as set into a Likert scale of 1 to 5, which shows a very uniform response for a positive role of each individual. The same was true for the teams (Table 2). However, prior experience with making of videos most likely gave more successful groups more time to focus on the scientific content.
On the other hand, the other two groups did not do poorly, rather they most probably would have needed more time and support with the technical implementation. It was evident that not all students are familiar with digitalized tools to the extent that they would feel comfortable experimenting with different types of presentations.

Group formation and group dynamics has been extensively studied for decades by many groups and there are an equally numerous amount of suggestions on what works and what does not work (Renkonen, 2017). We agree that the common goal uniting all approaches is, as aptly stated by Björklund et al. (2017) to encourage students to transform from *"Lonely riders to co-creators"*. However, as pointed out in the introduction of this paper, the aim of BIOMEETSMEX was to provide practical tools for creating an additional means for student reporting and creation of their own work, and not focus research on learning pedagogies. Accordingly, group formation was supported only by one short session. On the other hand, we do recognize the challenges of group dynamics and especially the need to harmonize the abilities to use rich media across all groups.

Moreover, there has been concern about the integration of non-native students, and particularly non-English speaking students into groups work (Gillie et al. 2017). On the other hand, as our University only offers M.Sc. programs in English, which is not the native language of our students, we argue that all of our students are in many ways in a similar position. Clearly also cultural differences may put students at a disadvantage during group formation and also needs to be taken into account.

One of the aims of the present pilot was to explore the possibility of creating a repository of student-produced videos. We have experimented with a very wide array of engineering education development, including project- and problem-based learning, distance learning, virtual spaces, MOOCS etc. Based on our own and the experience of others, written reports by students most commonly become filed and archived after a course, and most likely shredded a few years later. This is a great loss, as they contain a multitude of information, experimentation and reflections, but which very rarely is read by the students, or the teachers of the course in the following years. Accordingly, it would be important to be able to create a repository for student-created digital materials. Keba et al. (2015) have studied the creation of a video-hosting – platform by a team of librarians at Nova Southeastern University. The initiative, known as Library Learn, is an excellent example of how issues of usability, accessibility, updating and technical issues can be resolved. However, there are many additional challenges due to copyright, ownership, quality and legal ownership for content, which may be university and country-specific. Namely, student-produced videos often include a variety of other media resources, which brings complex issues of ownership as well as legal responsibility for content. Accordingly, even though a repository of student videos, which could also be possibly publicly available, and which is easily accessed by mobile devices is an interesting idea, it is still under deliberation for BIOMEETSMEX.

4 CONCLUSIONS

Video streaming is a very useful way to present and update data, project development and results. Moreover, video streams can be distributed independently of time and space to any audience rapidly. Armstrong & Massad (2009) have studied student learning in production of podcasts and state that this encourages students to research, analyze information, communicate effectively, and incorporate expert opinions into their production. Conceptualizing scientific facts has been shown to enhance student understanding of complex biological phenomena as well as abstract thinking (Nordström & Korpelainen, 2011; Passera, 2017). Moreover, by actively producing their own work and comparing it to the work of others gives students important feedback for reflection on their own capabilities. It also inspires them to try to expand their creativity and innovative abilities (Armstrong & Massad, 2009). We would also argue that similar to the production of podcasts, that video documentation of the student's own work has a knowledge-creating value, and they are a vehicle for disseminating learner-generated content in accordance with Lee et al. (2008). As stated by Armstrong & Massad (2009) these forms of communication promotes learning for the desired outcomes of a course.

The notion that universities are filled with natural diginatives is more of an assumption or wishfull thinking, than the truth in everyday teaching. As suggested by Amstrong & Massad (2009) it may be wise to assess the technical capabilities of the students prior to the formation of groups to ensure that students with more knowledge of video reporting or similar digital technologies are present in each group, which evens out the skill level.

Smyth (2011) emphasizes also the role of the teacher in student generated video communications. Namely, the teacher does not feature prominently, rather the role of a planner, learning designer and facilitator. Moreover, as the teacher has the final responsibility for the learning outcomes (Mayer, 2004) it is important that the teacher stimulates the students, provides encouragement and motivates students towards achieving the learning outcomes (Anderson et. al., 2001; Smyth, 2011). This is in line with learning and teaching in virtual environments, where the role of the teacher becomes more immersed and the student – teacher hierarchy is dismantled (Qvist, et al. 2015).

BIOMEETSMEX is an example of a co-creation approach aligned with design thinking principles (Koria, Graff & Karjalainen 2011; Hasso Plattner Institute of Design at Stanford, 2015; Björklund et al., 2017). Accordingly, the pilot phase of BIOMEETSMEX has been completed in 2016-2017, the iteration phase has been ongoing during 2017, including analysis of student and teacher feedback. The concept is currently tested as a course "prototype" in 2018, to be re-iterated during a 2nd phase and finalized for the curriculum in 2019.

Our current efforts during the 2nd iteration phase are on creating more online-materials based on teaching videos from YouTube, both by commercial and other experts around the world, as well as student self-produced videos, from the previous years. An online exam base on e-learning reading materials, the video materials and the student lab-projects is currently being tested. These developments allow for a wider participation of students from different disciplines, who have expressed interest in the course, but who have no biotechnology nor mechatronics background. Due to safety regulations they cannot be allowed directly into regular cell and tissue course work nor would they satisfy the requirements for the M.Sc. level MP prerequisites. Work also needs to be done to clarify the instructions and on group formation, so that the technical abilities for video or other media production are adequate in each group. Our list for future work also includes, creating a repository for student self-created videos. However, as discussed above, this adds some additional challenges due to copyright, ownership, quality and legal ownership for content, it is still under deliberation.

According to our experiences, the key to learning is motivation, which stems from students enjoying learning. Such motivation can be achieved through digitalized means of presentation, where students actively co-create their learning. We also argue that each educational ecosystem is a co-creation platform, which is needs to implement educational tools in a manner that suits the student mindset. Importantly, intuitive, creative and future ways of working are promoted by trusting the ability of students to be the drivers of such ecosystems.

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