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Hands-on Project Based Learning during lockdown – Lessons learned and what does the future hold?

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The Faculty of Aerospace Engineering at the Delft University of Technology has an active learning philosophy which is embedded in its curriculum. The first year project Design and Construction is run in the second semester. The course aims to provide "hands-on" experience to students in design and construction. Applying knowledge from courses and developing interdisciplinary (soft) skills. A total of 400 students are divided into 40 groups of approximately ten students which are given several design challenges during the project. At the end of the project a final design challenge is given to build and test an aluminium wing design. In March 2020, half-way through the project, the Dutch government announced a nationwide lockdown which resulted in the University being closed to students and the remainder of the academic year being offered online. This paper will reflect on the challenges, solutions and online experience of the project and examines the on-campus v.s. online experience. The conclusion can be drawn that the learning objectives can be reached both on-campus and online. As was found in previous studies, online requires a common collaboration program and more structure to meet or exceed on-campus education. There is an advantage for online looking at the student grade data.

I. Introduction

THE use of Project Based Learning (PBL) provides students with "hands-on" experience in "real-world" engineering problems that are not possible to teach with courses alone. ABET accreditation requires to describe the major design experience that prepares students for engineering practice [1]. Universities worldwide use project-based-learning as a corner stone in the engineering curriculum. At Delft University of Technology, aerospace engineering projects enable students to synthesize knowledge by for example, a Design Synthesis Exercise or Capstone project [2].

For the Design and Construction project a team of 10 students are tasked to perform three design challenges in 14 weeks. The course objective is to introduce students to the engineering design cycle, learn soft skills like working together and to use project management skills/tools to successfully complete their project. Unlike other course in the first year which focus on teaching new content to students, the project aims to place students in a position where they need to apply what they have previously learned in other courses in order to meet an engineering objective that does not have a single solution. In this way the students explore technical feasibility and look at the given the constraints. The deadlines are final which in most cases means student do not have sufficient time to make a detailed design and look at all the options. This means student are encouraged to make engineering judgement calls and describe the decisions made in the report.

This paper begins with a brief review of the literature on PBL (Section II). Section III presents the primary goal of the Design and Construction project and how it is set up to achieve this. How the project had to be adapted as a result of lockdown measures during the pandemic will also be addressed in this section. The student survey results after lockdown run #2 and the observations on student performance by staff and student assistants are both presented in Section IV, see Figure 1. A reflection and discussion of the lessons learned will be presented in section V, while conclusions are presented in Section VI.

II. Review of Problem Based Learning

The Faculty of Aerospace Engineering at the Delft University of Technology has an active learning philosophy which is embedded in its curriculum. This is done by having a total of 5 project based learning projects in its Bachelor

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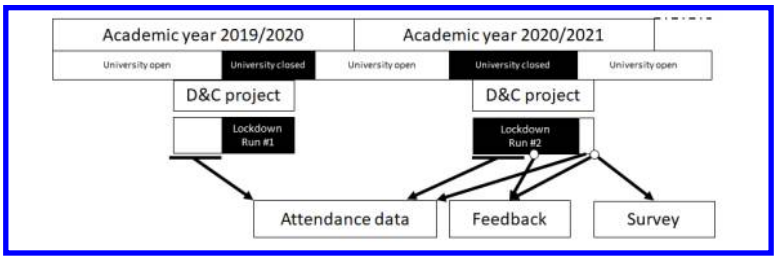

Fig. 1 Overview academic years 2019 - 20201 with the closing of the university and the lockdown runs of the Design and Construction project. The arrows show the points in time where attendance, feedback and the survey was performed which is analysed in this paper.

program (BSc). Two projects are given in the first and second year and one final Design Synthesis Exercise project in the third BSc year. Project based learning is embraced worldwide by the educational community to be an effective learning tool. It enables students to synthesize knowledge they have acquired in a Design and Construction project or more broadly in a Design Synthesis Exercise. A widely cited and important synthesis of research on learning is the Seven Principles for Good Practice in Undergraduate Education [3]. The principles rest on 50 years of research on the way teachers teach and students learn, how students work and play with one another, and how students and faculty talk to each other. The first three principles are:

1) good practice encourages student–faculty contact
2) good practice encourages cooperation among students
3) good practice encourages active learning

These three principles apply to both the college environment and the classroom, and they are the backbone of collaborative learning. In more recent studies it was found that cooperative learning improves a range of outcomes, including knowledge acquisition, retention, accuracy and creativity of problem-solving, and higher-level reasoning [4]. The authors found three factors that may contribute to these impressive results: quality of relationships (cooperative learning promotes increased liking among students); psychological adjustment (cooperative learning improves, for example, self-efficacy, self-concept, integration into the environment, and ability to manage difficulties); and positive attitudes toward the university experience (cooperative learning tends to promote more positive attitudes toward learning, the subject area, and the university). Students who learn in small groups together exhibit higher academic achievement, motivation, and satisfaction than those who don't [5]. It should be noted that the amount of student learning and personal development associated with any educational program is directly proportional to the quality and quantity of student involvement in that program [6]. This highly cited reference found that virtually every institutional policy and practice can affect the amount of time and effort students devote to academic pursuits. This is especially the case for non-academic issues which can, in a negative way, significantly affect how students spend their time and energy.

Research has shown that project based learning increases Blooms' hierarchical level of learning [7] and achieves higher learning outcomes [8]. Project work is problem-based by definition. According to De Graaff and Kolmos Problem-Based Learning is characterized by a logical course structure and design, i.e. offering the right information at the right time, self-directed learning groups with lecturers facilitating the discussion and activities, and an assessment testing students' competence and progress rather than testing the student for "isolated factual knowledge" [8]. In general PBL is student-centred, taking place in small groups with the teacher acting as a facilitator, and being organised around problems [9]. Other PBL formats have since been defined of which one is *Inter-disciplinary learning* [8]. This PBL format relates to problem orientation and participant-directed processes, in that the solution of the problem can extend beyond traditional subject-related boundaries and methods. This principle is critical for organising the teaching, so that teachers do not just consider objectives within the known subject-oriented framework, but also consider problems or real situations. Another format is described as *Activity-based learning* [8]. Activity-based learning is a central part of the PBL learning process, requiring activities involving research, decision-making and writing. This can motivate and give the student the opportunity to acquire deeper learning. The Design and Construction project being discussed in this paper utilizes elements of both the activity and inter-disciplinary learning of PBL.

Research has shown that effective student participation in group work is important to achieve higher learning outcome for higher-education courses [10][11]. Studies examining the interaction of students during online courses found that interaction is limited by the technology [12]. However, it should be noted that since 2011 the technology has improved and digital skills of students and staff has progressed. Other research found that an online course requires

more planning and structure than onsite to be effective [13][5]. There is ample evidence that collaborative learning is as effective in online classes compared face-to face [5].

III. Design and Construction project

The Design and Construction project is the 2nd project of the First Year Bachelor Degree with approximately 410 students. The Design and Construction project is managed by 2 Staff members dedicated to the project and supported by 20 Teaching Assistants to help manage 40 student groups of approximately 10 students each. Each Teaching Assistant's has two groups which he or she will guide through the project during its 14 week duration. In order to facilitate the student's ability to prepare a final design report, a parallel Technical Writing course run by approximately 13 lecturers is embedded within the project. Additionally, three technicians are available to help with the manufacturing and testing needs of the student groups.

The project is scheduled in the 2nd semester of the academic year, spanning a 14 week period. At the moment the project begins, the first year students have completed basic engineering courses in engineering mechanics, material science, and aerospace engineering sciences. The Design and Construction project aims to allow students to synthesize and apply the knowledge gained in all of these courses.

A. Learning objectives

The following higher order learning objectives for the design and construction project are:

- Independently complete a full design cycle of an AE (sub)system
- Manage a complex team project under external guidance and reflect on its outcome
- Write an effective design report

B. Course setup

In order to meet the learning objectives the Design and construction project is setup to mimic a real life company, *Important Aerospace Company* or IAC, which focuses on aerospace related designs. The approximately 10 students in each group are in essence the structural design team which needs to accomplish design projects before a given deadline. By having each group work on several design challenges they get familiar with the aerospace design cycle and iteration process. As the project develops over time the design challenges get more complex.

Another important aspect of the project is team work. By having 10 random students the skill of working together is enforced as it is not possible to finish the project within the allotted time-frame. During the project sessions students are guided by staff and student assistants. For the assessment the design report, drawings and a production plan of each group are graded.

To get students started, a simple space structure is selected with the focus on assessing the selection of an appropriate material (coupon level) for the given design. The space structure is the rocker bogie of a planetary exploration vehicle, similar to the NASA Spirit and Opportunity rovers deployed on Mars. The students explore technical feasibility and look at the given the constraints to try to come-up with a design. The assignment is meant to get the team started on and get familiar with an open-ended project. This is also the first time an engineering design report is introduced as a deliverable.

In the next step of the project, the complexity is increased to design a compression panel. The back story to the compression panel is that the planetary exploration vehicle needs to be transported and launched by a rocket. The compression panel is part of the launch vehicle. For this design, the students have a bit more design freedom and multiple variables to come to grips with. The compression panel face sheet (thickness), and stringer (size and number) can be selected. A pre-defined (compression) design load is given which needs to be met. At this point in time, students would have had courses mechanics of materials. Contrary to the previous assignment, the time frame is tight and more work needs to be done in a shorter amount of time. This is part is due to the logistical fact that the panel needs to built and tested within the schedule of the project 2.

In the final quarter, a wing design (box structure) is chosen to exemplify the mechanics of material and engineering courses which students have completed by that time. In the wing design challenge more freedom is given with multiple design variables. As the students are now familiar with the project setup, and the design team has been working for 7 weeks together it is time to show what they have learned, and more independence is required. Therefor the guidance and support are less than in the two previous assignments. During the project student get the chance to build there design 3 which are then tested to see if they meet the design requirements 4

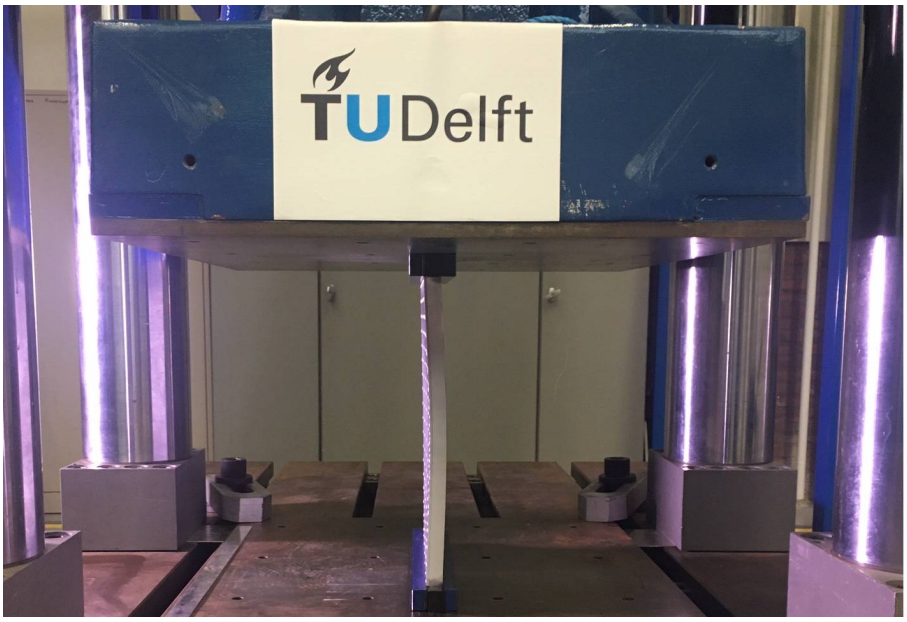

Fig. 2 Compression Panel positioned in test machine.

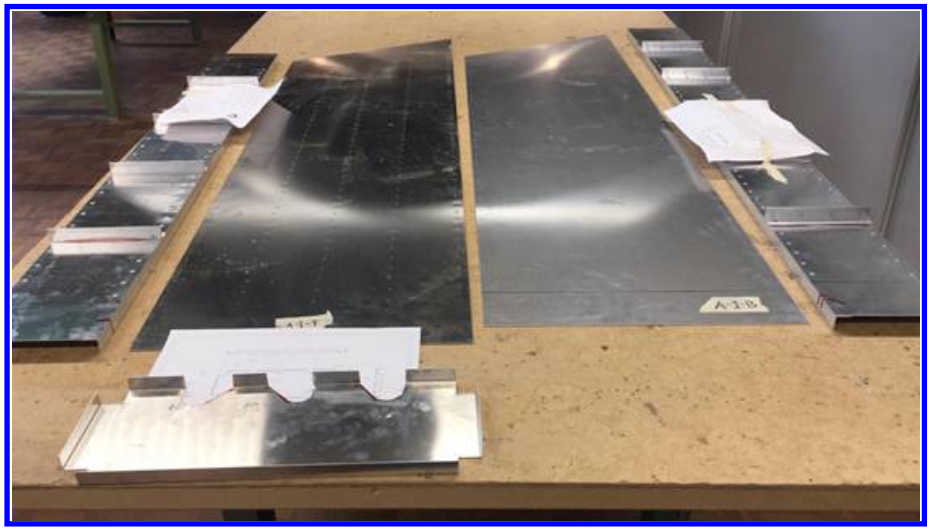

Fig. 3 Material cut and prepared for wing manufacturing.

C. Course change due to lockdown

For first year students the Design and Construction project is one of the highlights of their year as they get the chance to build and test their own design. Due to the lockdown and closing of the university, the building and testing aspects of the project could not be completed as they had been in the past. Instead, an alternative building solution was found in which students were tasked to create a robot motion plan. Thus, rather than building their designs by hand with regular hand tools, they focused on what would be needed to program a KUKA robotic arm 5 to carry out some of the manufacturing steps such as drilling of all of the mechanical fasteners holes in the various parts of the wingbox. As the Delft Aerospace Structures and Materials Laboratory (DASML) had a Kuka robot available and software knowledge was present to accomplish this. The manufacturer was more than willing, given the COVID lockdown and circumstances, to provide 500 licences of the robotic arm simulation software to help out.

It should be noted here that although this alteration of the project may seem significant in terms of changing the learning experience for the student, it in fact does not result in any of the learning objectives of the course being

Fig. 4 Five Wing designs in testing rig with distributed load ready to be tested.

Fig. 5 RoboDK software package for manufacturing simulation. On the floor the different wing panels and stringers which needed to be drilled.

jeopardized. The aim of the course was not connected to teaching students how to manufacture, but merely to get a sense of how manufacturing and aspects related to manufacturing could impact and influence a design. The assessment is based on the report and no grades are given for production and manufacturing.

IV. Observations and feedback

A. Survey results from students

At the end of Q3 and Q4 during lockdown run #2 an opportunity was given to students to give textual feedback for improvements and comments for the project. In table 1 an overview is given of the textual feedback. The textual feedback provided as comments was ”NO MORE ONLINE. EVER.” And “on-campus sessions were the most efficient we had since communication was so much easier.”. To the other end of the spectrum: “Working online is becoming an essential skill in engineering”, “When corona is over, keep the online part in.” and “Some parts of the project work better online while others work better in person. What did stand out was the increase in negativity between the Q3 and Q4 comments from students. This in part can be explained by the duration of online courses during the study, by the end of project survey, this would be 9 months of which 4 moths of lockdown (no-campus).

Table 1 Feedback comments during lockdown run 2.

	Q3 comment feedback	Q4 comments feedback
“Back to campus”	5	21
"Great doing project online"	8	2
"Hybrid format online and on-campus	0	3
Absent	123	120

After lockdown run 2, a survey was send to students on feedback and experience related to the Design and Construction course the questions examined the online v.s. on-campus experience. Staff wanted to find out what the students were thinking of the project being online.

The results of the survey can be found in Figure 6 t to doing the project online. Approximately 65% of the students did not agree with the statement: I liked doing the project (largely) online. A similar percentage, 65%, did not agree with the statement: Doing project online was more effective online compared to on-campus. A third question; It was easier to meet deadlines working online yielded a mixed result with 50% not agreeing. It is evident that students are negative on doing online project work. On a different note, the fourth and final question: I feel prepared for an online work environment in the future? A majority of 70% answered positively. In other words student did manage to work online and learned something.

B. Observations staff

During both project runs a notable difference was observed by staff on student performance. Apart from student (soft) skills which improvements are hard to quantify, a notable difference in attendance and grades, which can be quantitatively measured, were observed and will be further discussed below.

1. Attendance

In 2019-2020 the first part of Quarter 3 (Q3) the project started on-campus. This was before the first lockdown went into effect. The attendance data taken before the lockdown began was taken as reference for on-campus sessions. The following year in 2020-2021 the project started fully online in Q3. Comparing the Q3 on-campus and online attendance data shows a significant decline in absenteeism and tardiness in favour of online, see table 2. It could be argued that this difference might be attributed to the different cohort of students; however, it was also observed that at the end of Q4 in 2020-2021, when the 2nd cohort of students were allowed to come partly back to campus, the tardiness rate for students choosing to come to campus was significantly higher than for those choosing to follow online, See Table 3. It should be noted that a total of 3 session were on-campus where 35% of the student did not elect to come. This meant that 3 hybrid session were also counted as online.

Table 2 Design and Construction student attendance data for academic year 2019-2020 (on-campus) and 2020-2021 (online) period Q3.

	2019-2020	2020-2021	
	Q3 on-campus	Q3 online	
Students	406	405	
Sessions	10	14	40% more sessions
Absent	112	20	82% less absent
Late	967	258	73% less late

2. Project grades

Another observation made by both the Staff and Teaching Assistants during lockdown run #2 was the increased performance and understanding of the students. The students seem to be more independent and asking more relevant questions online. The students were able to ask questions but a higher barrier was present to ask it online. On-campus

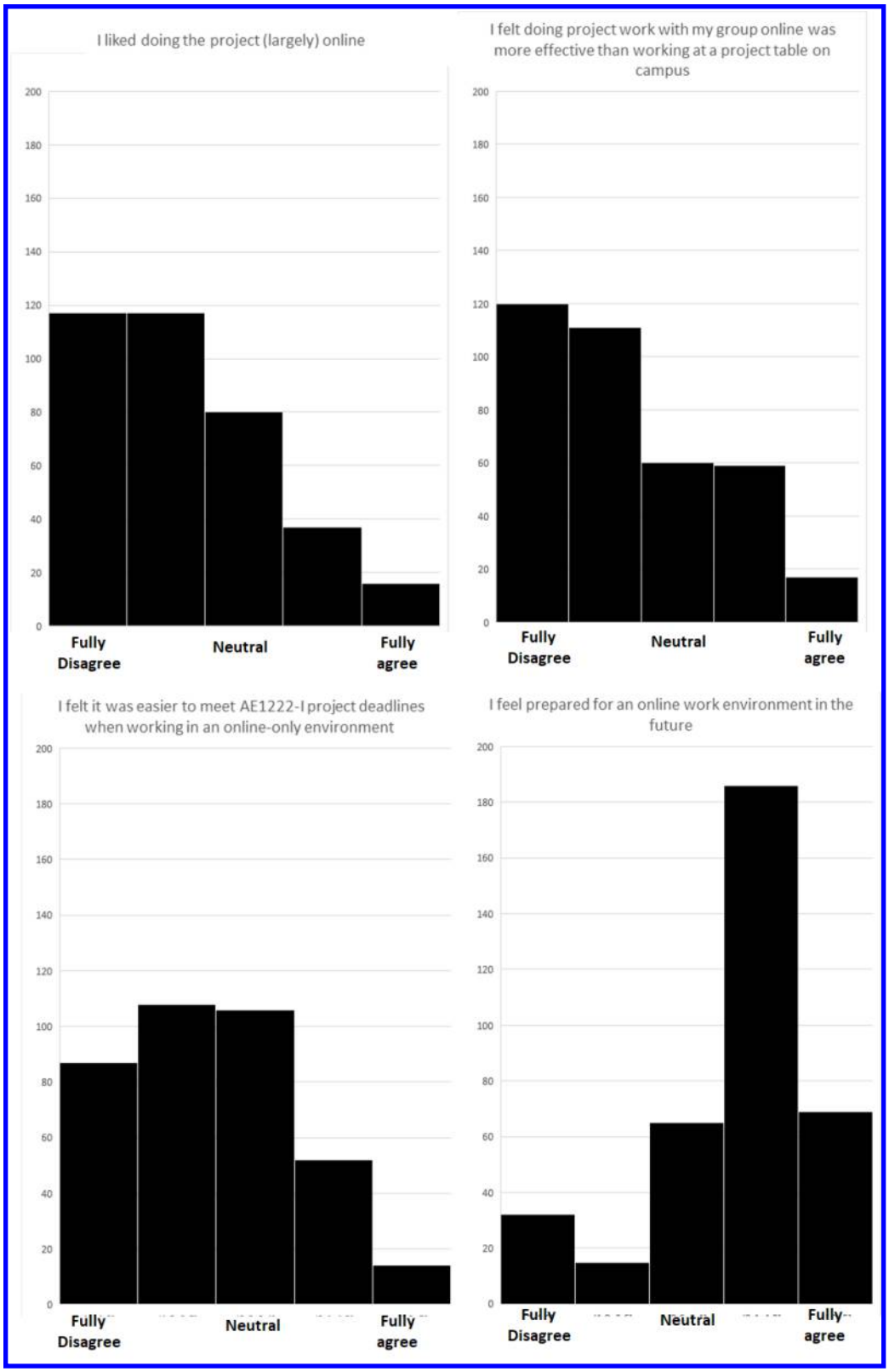

Fig. 6 Survey results with the four statements students were queried on.

Table 3 Design and Construction student attendance data for academic year 2020-2021 period Q4 on-campus and online.

	2020-2021	2020-2021
	Q4 on-campus	Q4 online
Students	390	390
Sessions	3	9 (+3 hybrid)
Late total	47	71
Percentage late	6%	2%

students could walk to a Teaching Assistant and ask a question right away. In many cases the question was easy to answer and had no merit. If the student would have read the provided project information material better the question would not be asked. Now, online, this barrier to ask a question meant students spent more time actively reading the material and not right away ask a (useless) questions but in fact asked more in-depth and valuable (background) questions.

For the personal grades 7 a similar increase in grades for online was found. As noted by staff and Teaching Assistants the more structured meeting that is required online makes all group-members to have their say. The division of work online meant that students were able to assess better who did what and to which quality level. This knowledge meant that the feedback and peer grading was more representative and easier to give.

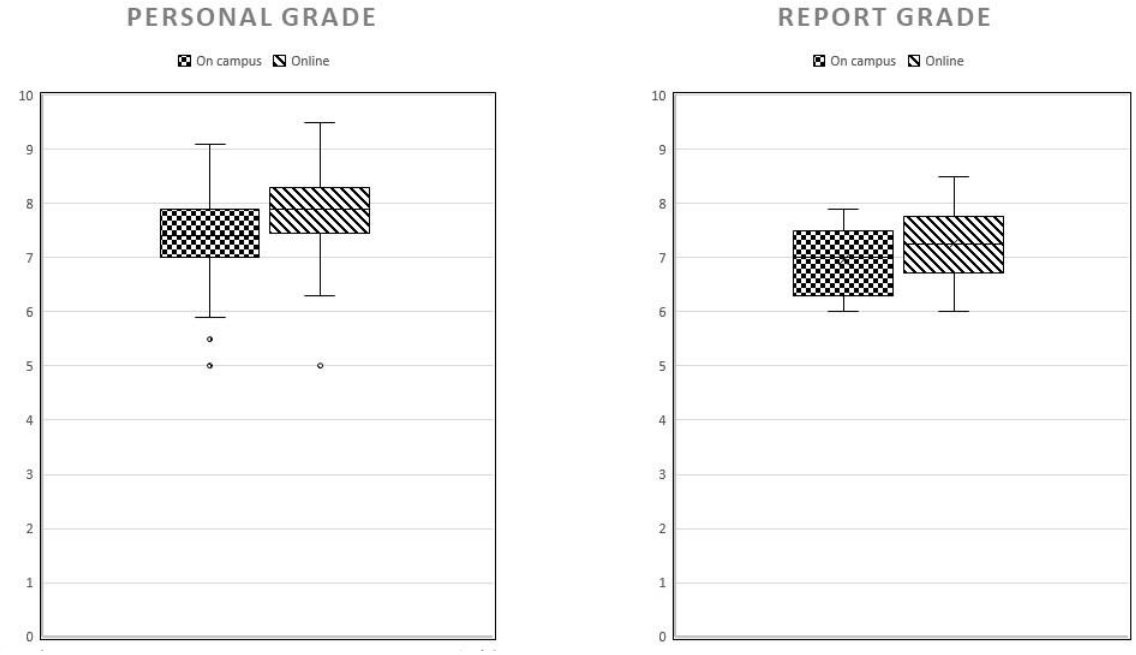

Fig. 7 Comparison personal and report grades for on-campus and online.

V. Reflection and lessons learned on-campus and online project

Research studies of good practice in college and university teaching point to collaborative learning as an effective method of instruction. However, the research also shows that certain boundary conditions need to be met in order to ascertain the higher-order learning objectives of student development and skills during collaborative project work. During the lockdown runs valuable insight was gathered by talking to students and Teaching Assistants. This section will elaborate on the lessons learned and provide reflection on what was found.

A. Defined Collaboration Program

By switching from bi-weekly sessions at a project table on-campus to digitally working together in a group meant a tremendous switch for both students and staff. The feedback received by students after lockdown run #1 made it apparent that a set structure and program for collaboration was required. This was also found by research, which concluded that an online course requires more planning and structure than onsite to be effective [13]. For lockdown run #2 the structure was in place and contingency planning was achieved. By having a single defined collaboration program (MS Teams) with a stable internet connection the first step in a solid learning foundation where students could collaborate and get support from staff and Teaching Assistants was met. During lockdown run #2 the project ran considerable more smoothly as a result of this more organized and cohesive approach.

B. Increase and Structure Formal Communication

A second lesson learned was the importance and impact of formal communication. It was observed during both lockdown runs of the project, there was an increased need for students to prepare and transmit more formal communications. Online has a higher dependency on written and effective communication. The challenges on effective communication is placed on students during online group meetings, which inevitably forced students to think more about what they needed to communicate and how best to communicate it. It also engaged students to find information themselves (ie: deadlines and deliverable requirement details), whereas before students would rely more on the information they overheard or rumours flying around the project groups which was facilitated by students being located in large project rooms with multiple groups. During periods of online collaboration, however, they were more isolated from groups other than their own. Thus, the more focused online discussion and collaboration, in effect, required the need to fill the informal information gap.

Both staff and Teaching Assistants noted that the questions from students were of higher quality as students would think more about it before asking. Whereas before, on-campus, students would walk to the Teaching Assistant or staff member to ask a question during project session. In many of these in-person questions, the student made no effort to consult with fellow students or read the information in the project syllabus/reader that was provided before asking their question. The fact that during online students had to make an effort to ask a question in the Q&A system. In many cases this meant that before taking this effort the student would have consulted fellow students, and in most cases come up with an answer themselves. The questions that were left were in many cases the difficult ones.

If the appropriate structure and course information is in place, another important condition needs to be met in order for this information to be received. Students need to be aware and know how to use the learning management system where course information is provided and how to interact with this information. Although this sounds trivial, it was found during the 1st lockdown run that this was certainly not the case, which resulted in a communication breakdown between staff and students. One example of this was the common belief by students that after reading the project reader once, there was no need to go back and consult it through the rest of the project and that any important details within it would be re-communicated at later points in the project when they became relevant. Additionally, it was a surprise to the teaching staff that many students didn't understand that they should consult the Q&A section of the learning management system and check for announcements posted within it on a regular basis. This was one of the lessons learned and a manual was created how to use the learning management system.

A positive side effect of the online environment was the increased opportunity for staff to interact with students. Because there was a common platform for communication a coffee with the main instructor was organized with random students from different groups throughout the project. This effectively gave each students an opportunity to meet and discuss with the instructor without radically interfering with project work as the student could easily excuse themselves from working online with their project group to join the online meeting with the instructor.During these half-hour informal meetings, the main teacher provided students with an opportunity to raise questions and topics for discussion, which the students greatly appreciated. Although something similar would be possible to arrange on-campus, it will entail more logistics in organizing a room. Project staff members also indicated their sense that the amount and quality of the interaction with students in an online environment was much greater than what had been experienced on-campus in previous years. Having an online meeting, as studies have shown, was very productive and efficient.

C. The (un)willingness to Change

During the two lockdown runs, an open dialog was started with the students about the drawbacks and benefits of online and on-campus project education. Both students and Teaching Assistants were hard to convince looking at the attendance data being in favor of online. As many were of the opinion that on-campus sessions were much better.

When asked once more why they were of that opinion the overall argument was given that working on-campus was simpler. Asking again why it was simpler, the overall answer that was provided was that working together was more fun on-campus than sitting at home. Note that this answer reflects the previously identified lockdown fatigue where the only opportunity to go to campus was for the project. This latter statement is exemplified by feedback from the end of course survey where students were asked about effectiveness of online v.s. on-campus project sessions. Several students acknowledged verbally, and in survey feedback that project sessions on-campus were less effective because this was the only opportunity to see other students. At the end of Q4 in 2020-2021 both staff and Teaching Assistants noted that on-campus students would have fun and talk during their session. Another interesting observation was that outside project hours project tasks, that were not accomplished during on-campus session, were then completed online.

A common example of a drawback and what was missed that student brought up was the manufacturing and testing of their design for the project. Students see the building and testing as an integral part of the project and fun to do. However, it is not a necessity from a learning objective standpoint. Providing the design and data of an example wingbox to be analysed is sufficient for reaching the learning objectives. During lockdown run #1, a digital manufacturing alternative was introduced to replace the physical manufacturing of the wingbox by the students. For the first run this was accepted as an appropriate alternative. Learning and applying digital manufacturing methods was identified as an important experience that would have a lot of application in their future engineering careers, and it was overwhelmingly indicated that it should be incorporated into the project in future years. However, for lockdown run #2, the comments were not positive as it was seen as replacement for manufacturing that was again not possible, rather than an evolution in the learning activity that was still aligned with the learning objectives of the course. The acceptance level was lower compared to the previous year. As the lockdown continued, feelings of isolation increased. This lead to students focus more on what was not possible and what they perceived they were missing out on as a result of the pandemic situation. The feeling of missing out became more dominant, and campus was seen as the place to be. The end of the project survey questions 1 shows this trend.

Feedback from Teaching Assistants and staff observations related to student participation was more positive for online. The on-time attendance online was 80% better than on-campus. Although these numbers are indicative, one should not underestimate the effect of COVID lockdowns during the project. By having online project students did not have to travel, which meant that seconds before the project started student logged in and started working. Whereas if the project was on-campus, the impact of sleeping in or encountering a raised bridge at a canal delaying a students journey to campus (a perhaps uniquely Dutch excuse for tardiness) can not be ignored in their impact on attendance. A recent study by the Dutch Government showed that 80% of the students liked online because there was no travel time [14]. The amount of the absentees for online session was 80% less than for on-campus. Again, the lockdown period plays a role here as extracurricular activities were for the most part non-existent, resulting in students having and using more of their available time to focus on studying. Another factor that was identified by staff was that there were no distractions and student would actually read the information provided for the project.

The primary focus of students, especially first-year students, is on the course assessment and the final grade. Because of this perception of grades and assessment being of the utmost importance, they often believe that instructional activities are chosen to align directly with the assessment and student success in this assessment. Thus, in students view, having an on-campus session whereby it's easy to talk and work together allows them to achieve a high grade. This is equivalent to taking the *learning objective* element out of the constructive alignment model used by teachers to design their courses. The higher learning objectives and skills being taught in a course are often not considered by students. However, does this mean they learn and reach the learning objectives set for the course? A high grade of the assessment means that a student fulfilled the learning objectives for the course. However, that does not mean the instructional activity is appropriate to reach the learning objectives and as a consequence, a higher assessment can be achieved.

Research has shown that student participation in group work is an important learning outcome for higher education courses [10]. Therefore, the instructor, not a student, must be conscious of how best to facilitate efficient collaborative learning in which ever format. In a recent study by the Dutch government in which students and universities were interviewed show that group work is favoured to be on-campus as opposed to lectures which were deemed to be more effective online. However, as indicated in this study, there were exceptions to the rule. From comparative studies between online and on-campus, courses have found students are likely to blame the technology instead of group organization and cooperation for failing project work. The feeling that online is 'harder' compared to on-campus relates to the amount of training and the task that is to be accomplished. As noted by feedback from students, some tasks during the project are suitable to be online whereas other tasks may be less effective.

In this case due to the pandemic, the project was forced to be given online. A change that was not seen as a viable option before, was now mandated by government due to public health reasons. In general terms the grade average did

not drop, in fact there was a slight increase in the final report and personal grade for online compared to on-campus. Despite this and as mentioned before the perception of students that on-campus is better results in the third identified important factor; change.

The (un)willingness on reflecting on both the positive and negative of online and on-campus project has to offer is tainted by negative lockdown experiences. Students, after a prolonged period of online learning, long for on-campus education, despite even identifying themselves that online skills may be more important in the future. As one student mentioned in feedback; Working online is becoming an essential skill in engineering. Furthermore, having a course online does not mean there is no reason to come together to campus. As mentioned before in the communication section, communication between students and staff is vital to be present. Students feel that online provides less of an opportunity to talk to staff compared to be on-campus. In practice, staff could interact with students more online than before.

VI. Conclusion

Lockdowns and forced (emergency) online education took its toll on both students and staff. In general, lockdown education is considered to be a dark stressful time which many would like to forget. As a result students demand physical education is preferred and in some cases mandated by the government. However, there are opportunities to discover on how learning objectives were achieved and reflect on what benefits online project education yield.

Although project education is considered to be more effective on-campus, staff perception and data does not support this for the Design and Construction course. As research has shown that both online and campus courses can achieve similar outcomes and thus the method of teaching does not matter. After two years, running the Design and Construction project online the following key factors were found to be vital to make online group work a success:

A. Collaboration

It is essential that one online collaboration tool is chosen for running an online project. Some training and additional tips and trick on how to work together online is important to overcome the online. Of course, a stable Internet connection and online etiquette by students will ensure a smooth online collaborative environment.

B. Communication

Similar to collaboration it is essential that one communication tool is chosen. For universities and colleges, this is in most cases the learning management system. Because of the absence of informal lines of communication (during a lockdown) the formal lines of communication must address and provide essential information to students. Of note, student should be trained by clear supporting material to use the learning management system and regularly read the updates provided.

C. Change

The negative lockdown experiences by students and the continuation of online courses lead to a pessimistic perception. The fear of missing out and what was possible before shielded students openness to a new way of learning and applying knowledge.

The first two factors related to a solid course structure and online learning communication and collaboration platform. These two factors will ensure a similar online experience as on-campus. Given enough preparation time both can be achieved by the course instructor. The third identified factor, change is a student factor with a long term time-frame. The chance factor is more difficult to address as students will, at least in the first years, resist online as other students would have done the course on-campus. Changing the course name and setup would help in the student acceptance level.

The question that would be more pertinent to ask; which skill is required to be taught to students for working together to be ready for the future. Currently, there are indications that online or hybrid working will be more common and employers are accepting a different work-life balance. A such, it is very conceivable the next generation of engineers is required to be proficient in being able to work together both in person as online. As such universities should work on Change to provide the best education possible to future engineers. A mix of in person and online for both courses and project education should be part of future curriculum.

VII. Acknowledgement

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