Remote work is in my blood - reflections on motivating first year students during the COVID-19 pandemic

Rans, C. D.; Teuwen, J. J.E.

Publication date
2021

Document Version
Accepted author manuscript

Published in
Proceedings - SEFI 49th Annual Conference

Citation (APA)
Rans, C. D., & Teuwen, J. J. E. (2021). Remote work is in my blood - reflections on motivating first year students during the COVID-19 pandemic. In H.-U. Heiss, H.-M. Jarvinen, A. Mayer, & A. Schulz (Eds.), *Proceedings - SEFI 49th Annual Conference: Blended Learning in Engineering Education: Challenging, Enlightening - and Lasting?* (pp. 1184-1192). (Proceedings - SEFI 49th Annual Conference: Blended Learning in Engineering Education: Challenging, Enlightening - and Lasting?). European Society for Engineering Education (SEFI).

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

REMOTE WORK IS IN MY BLOOD - REFLECTIONS ON MOTIVATING FIRST YEAR STUDENTS DURING THE COVID-19 PANDEMIC

C.D. Rans
Faculty of Aerospace Engineering, TUDelft
Delft, the Netherlands
https://orcid.org/0000-0001-5539-1262

J.J.E. Teuwen
Faculty of Aerospace Engineering, TUDelft
Delft, the Netherlands
https://orcid.org/0000-0001-9610-3167

***Conference Key Areas**: Methods, formats and essential elements for online/blended learning, Social aspects and communication in online/blended learning*
***Keywords**: Motivation, student well-being, blended education, online education*

1 INTRODUCTION

Transitioning from high school to university is tough, but doing so in a year where campus is effectively shut down due to a global pandemic is especially tough. Isolation from peers, dissociation with a campus they may have never even visited, and limitations on the amount and mode of live interactions with teachers all can take a toll on the intrinsically motivated first year student. This was the challenge faced by the ~450 student first year cohort of the Bachelor of Aerospace Engineering degree at Delft University of Technology (TUDelft), of which ~40% are international students. A unique approach was taken to motivate students to persevere and navigate themselves through these challenges by leveraging the common interest of their degree - aerospace. Students were asked within an introductory engineering mechanics course to assume the role of a pioneering astronaut on a journey to become the first person to set foot on Mars. Using this form of role-play, strategies and solutions to overcome the aforementioned challenges were given to the student that allowed them to gamify their approach to dealing with the pandemic situation. In this paper, we will present the main strategies and solutions, along with their analogy to a long duration space mission, that were employed in the course, and reflect on their impact on student performance as well as student well-being.

2 COURSE CONTENT

To set the context for the strategies used during the COVID-19 pandemic period of online education, an overview of the course content and learning objectives is presented. The course, entitled *Statics*, is an introductory course in Engineering Mechanics which is commonly taught in the first year of many engineering degree

programmes. In the Aerospace Engineering bachelor programme at TUDelft, this course takes place in the first quarter (7 weeks) of the first year of the bachelor programme. The course in its content is not fundamentally different from other similar courses taught in Mechanical and Civil Engineering degree programmes; however, being taught in an Aerospace Engineering faculty, the context for learning was heavily focused on the analysis of aircraft and spacecraft. An overview of the learning objectives and the organization of the course are given below.

2.1 Learning Objectives

At the end of this course, the student will be able to solve basic problems dealing with statics. They will be able to:

- Define the basic terms in statics such as force, moment, body using the appropriate units and notations
- Use Newton's 1st law to determine the reactions on 2D and 3D bodies and particles in equilibrium
- Calculate the centroids and mass and area moments of inertia of elementary shapes (including thin-walled structures)
- Analyse whether a structure is kinematically and statically determinate and calculate the normal forces in a truss
- Calculate and construct diagrams of the distribution of internal normal forces, shear forces, bending moments and torsion moments as a result of external loading including distributed loads following a standard definition and recognise when diagrams do not follow this definition
- Use the principle of virtual work to derive internal and external forces and moments of structures and systems

2.2 Course Content Overview

The table below provides an overview of the content of the course. Each week consisted of three 2hr lecture slots, and weekly homework assignments (COZ), weekly quizzes, and instruction sessions. Instruction sessions are held in smaller groups of no more than 40 students and are led by teaching assistants. They are not formal lectures, but sessions designed to promote supervised group interaction and problem solving. Colour coding in the table is provided as a visual means for students to identify what lecture topics are associated with what assignments, quizzes, and instructions.

Table 1: Course content and activity by week

	Weekly Quiz	First Lecture		Second Lecture		Third Lecture		COZ		Instruction
Week	Date	Module Prep.	Relevant Reading	Module Prep.	Relevant Reading	Module Prep.	Relevant Reading	Assignment	Due Date	Activity
1.1		1.1 Course Introduction	Brightspace course info.	1.2 Forces & Vectors	Ch. 1 & 2 (review from High School)	Static Equilibrium of a Particle	Ch. 3.1-3.4	COZ1	06/09/2020	Livestream in Teams
1.2	07/09/2020	2.1 Moment of a Force	Ch. 4.1-4.6	2.2 Modelling of Force Systems	Ch. 4.7-4.9	2.3 Equilibrium of Rigid Bodies (2D)	Ch. 5.1-5.4	COZ2	13/09/2020	Livestream in Teams
1.3	14/09/2020	3.1 Truss Struct's - Method of Joints	Ch. 6.1-6.2	3.2 Truss Struct's - Method of Sections	Ch. 6.3-6.5	3.3 Frames & Mechanisms	Ch. 6.6	COZ3	20/09/2020	Livestream in Teams
1.4	21/09/2020	4.1 Load Path & Int. Force Concepts	NVM Reader	4.2 Generalized Int. Force Relationships	NVM Reader	4.3 NVM diagram applications 1	NVM Reader	COZ4	27/09/2020	Livestream in Teams
1.5	28/09/2020	5.1 NVM diagram applications 2	NVM Reader	5.2 Resultant Forces & Moments in 3D	Ch. 5.5-5.6	5.3 Equilibrium of a Rigid Body in 3D	Ch. 5.6-5.7, 6.5	COZ5	04/10/2020	Livestream in Teams
1.6	05/10/2020	6.1 Centre of a Body	Ch. 9.1-9.3	6.2 Area Moment of Inertia	Ch. 10.1-10.2, 10.4-10.5	6.3 Mass Moment of Inertia	Ch. 10.5, 10.8	COZ6	11/10/2020	Livestream in Teams
1.7	12/10/2020	7.1 Virtual Work	Ch. 11.1-11.2	7.2 Virtual Work (cont.)	Ch. 11.2-11.3	Review Lecture		COZ7	18/10/2020	Livestream in Teams
1.8	19/10/2020	White Week								
1.9/1.10		Online Exam - Date TBD								

3 GDPR AND ONLINE TEACHING TOOL LIMITATIONS

A key boundary condition faced in delivering the aforementioned course online during the 2020/21 academic year was the available tools for online teaching. Due to GDPR requirements, there were only a limited number of online teaching tools permitted for use within the university. Of the tools available, only the Livestream functionality of Microsoft Teams could accommodate the class size of approximately 500 students. Unfortunately, this functionality is meant for broadcasting rather than interaction, which resulted in several limitations:

1. The use of cameras and microphones were not available to students. Communication from the students could only be achieved through a text-based chat functionality.
2. The broadcast nature of the livestream functionality resulted in a non-negligible time delay of one to two minutes between what the teacher was doing and what the students were receiving.
3. The use of breakout rooms could not be accommodated without students having to exit the livestream and enter a new platform or Microsoft Teams meeting.

These limitations resulted in an extra degree of separation between the teacher and student body and severely limited the potential for live interaction in lecture settings. This, combined with the awareness that first year students would feel isolated by the absence of face-to-face connections with their peers, became the trigger for the Mission to Mars analogy that the course was structured around.

4 THE MISSION TO MARS ANALOGY

The psychological effects of long duration human spaceflight have been a topic of concern and study for potential human missions to Mars [1–3]. Isolation, cultural clashes with crew members, and adjustment to a new environment can all have a significant impact on an astronaut's well-being and general performance. The same could be said for a student entering a new university programme during the COVID-19 pandemic. They would be entering a completely new environment transitioning from high school to university, likely have moved a great distance and entered a new culture to do so, and are isolated by the quarantine and lockdown measures in place

during this period of education. Yet, for many students studying a degree in Aerospace Engineering, a manned-mission to Mars is something they dream of taking part in.

This raised the question of whether an analogy between the period of pandemic education and a human space mission to Mars could tap into the intrinsic motivation and drive of students studying an aerospace engineering degree. The remainder of this section describes how the course team organized elements of the course to leverage this analogy in an attempt to help students on their journey through this pandemic period of education.

4.1 Loss of Time Perception

A major challenge for astronauts during long duration space flight is a warped sense of time due to the loss of familiar cues such as sunrises and sunsets. As a result, many activities an astronaut would normally self-regulate based on their own perception of time, such as exercise and meals, are rigorously scheduled.

The loss of time perception was identified as a risk for students as well. Studying from home meant the boundaries between studying and their personal life were blurred. Other factors, including the ability to watch recorded lectures in their own time, could further distort a student's perception of their progress within a course.

To combat this, the course team organized a blended approach to the course where special attention was paid to scheduling. The course was divided into five main activities:

1. **Lecture Preparation**: This activity involved completing online blended learning activities such as watching videos, readings, and polls to test conceptual understanding. This activity was unscheduled, but expected to be completed prior to the live online lecture.
2. **Live Online Lectures**: Live teaching interaction between the teacher and the entire class in a Microsoft Teams Livestream environment. These sessions focused on reflections on concept polling results, application of pre-lecture theory to problem solving, and question and answer sessions.
3. **Homework**: Required weekly homework assignments were administered through an online assignment platform known as *ANS*. Assignments were assessed as complete or incomplete based on whether the student made an honest attempt at solving the problems.
4. **Online Instructions**: Live online help sessions in groups of ~40 students. These session were run by teaching assistants and included interactive polling, problem solving, and the opportunity for students to ask questions in a more manageable group size than the lectures.
5. **Weekly Quiz**: A time-constrained graded quiz in the *ANS* platform. The quiz element provided a manageable weekly assessment and feedback opportunity and provided an opportunity to train students in the use of the digital examination environment that would be used for the course final exam.

Delivering the education online eliminated one of the biggest constraints that had driven scheduling in past years – availability of necessary rooms and facilities. As a result, it was possible to set up the weekly schedule so that all of the course elements worked together (see Figure 1). The traditional 2hr lecture slots were divided in half, to reduce the amount of continuous screen time for students, and to offset the extra pre-lecture preparation we were asking of students. The other half of these lecture time-slots were allocated to working on the homework assignments. This ensured that a set time was scheduled where students could work with each other to complete the homework. Online instructions at the end of the week served as a milestone for students to have completed the homework and learning activities of that week and provided an opportunity for seeking help before their understanding was assessed in the weekly quiz at the beginning of the following week. Teaching Assistants also reinforced staying on schedule and keeping up in these instruction sessions. Finally, it was emphasized that course elements could be completed within the work week, leaving weekends free for students.

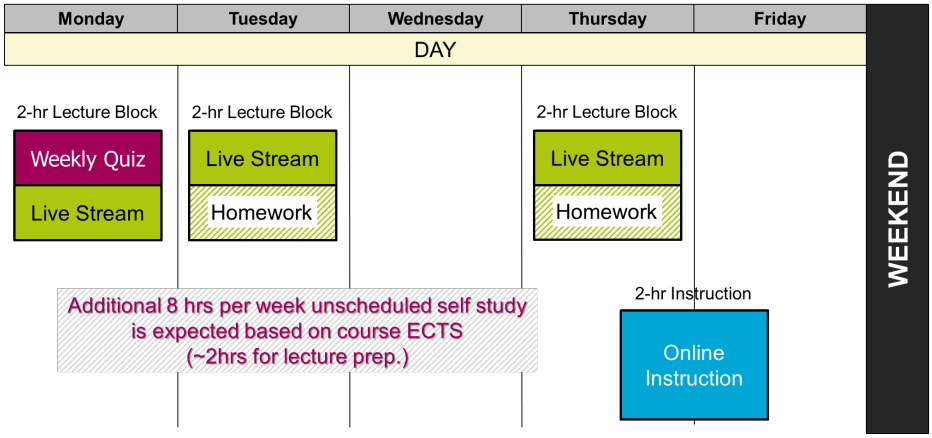

Figure 1: Weekly schedule of course activities

Although the effort put into scheduling and alignment of the learning activities may seem logical, it should be pointed out that this was overlooked by many teachers in other courses within the authors' institution. One of the biggest criticisms from students was the amount of additional planning needed on their side associated with all of the video and blended content added to the courses. So the actions of reducing the live lecture time to offset time spent on this additional content and scheduling activities such as homework were well received by the students.

4.2 Checklist and Procedures

During a long duration space mission, an astronaut is faced with many complex tasks that involve too many steps to commit to memory. Since the astronaut's safety often depends on the successful completion of these tasks, checklists are often used to capture critical information and record the successful completion of tasks. Although there are human factors related issues around checklists [4], they still serve a vital role in human spaceflight.

This risk was also identified for the incoming first year students. There was a higher reliance on students to manage course elements (ie: lecture preparations) on their

own and a danger that they could miss, forget, and/or fall behind on necessary activities with little awareness of the situation. To mitigate this risk, checklists for monitoring student progress where embedded throughout the learning management system used for the course (see Figure 2). These checklists were carefully designed to quickly convey key information. Open source icons from www.thenounproject.com were used to help students quickly identify the nature of the checklist item in terms of the needed actions of the student. Time estimates were also provided to help students in planning and managing their time. Most importantly, students could mark off completion of individual tasks, which could be monitored by the teachers to identify students who may be struggling and falling behind.

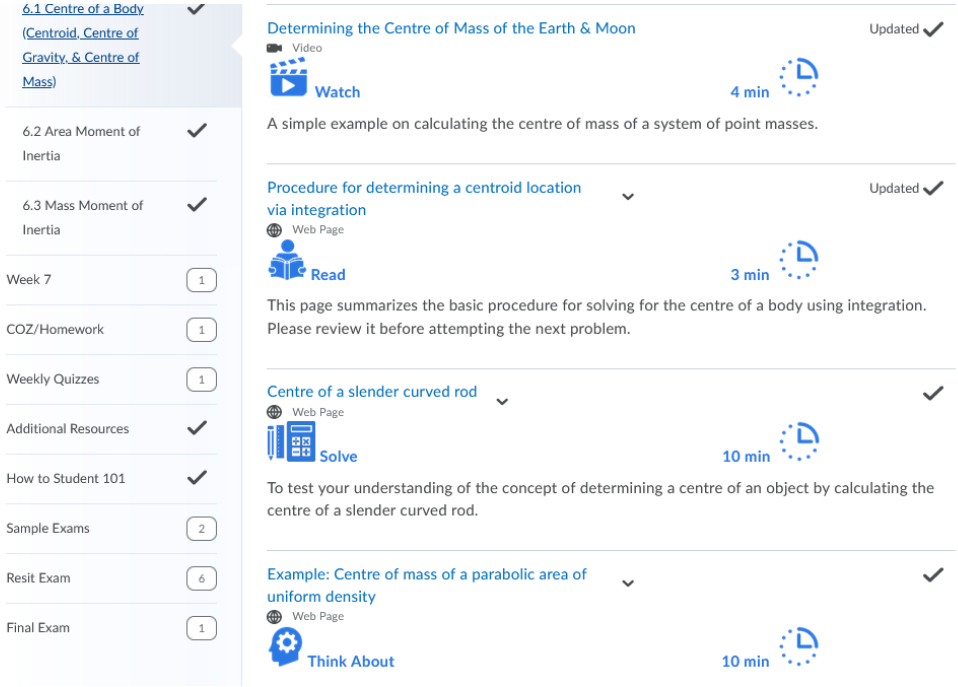

Figure 2: Lecture preparation checklist for a livestream lecture.

Although the concept of a checklist in a learning management system is not new, using the analogy of a human space mission helped convey the importance of using this feature to both the teaching staff and the students. Students greatly appreciated the ability to look forward into the course and see an overview of activities, time requirements, and get a sense of expectations. This was particularly appreciated during this period of pandemic education where uncertainty and ever-changing education conditions provided added stress to students.

4.3 Isolation and Loneliness

One of the largest concerns for long duration human space flights is the effects of prolong isolation on the mental well-being of the astronaut [2]. This was a major concern for all students during the period of pandemic education; however, it was expected to be particularly difficult for the incoming cohort of first year students who had not had the benefit of being on-campus, establishing peer groups, and adjusting to university life prior to the lockdown situation. This was further exacerbated by the

fact that approximately half of the incoming students were international and experiencing a new country and culture while being isolated in lockdown.

In combating this, it was recognized that more contact with a teacher would not be the solution. Students would be missing the contact and interaction with peers and the normalcy of traditional campus education. This is analogous to an astronaut missing friends, family, and their terrestrial life back on Earth. More contact with mission control does not effectively alleviate this, which is why it is important for astronauts to be able to send and receive recorded communications to friends and family back on Earth.

To replicate this within the course, the lecturers tasked the teaching assistants to be creative in creating a recorded weekly communication to the students. The lecturers only provided the teaching assistance with three high-level objectives:

1. Provide a student's perspective on the relevant context for course material
2. Help students feel connected to the campus and faculty
3. Give study tips and advice from a student's perspective

Beyond this, the lecturers stepped back and allowed the teaching assistants to run with the concept without interference. An example weekly message from the students (which they entitled How To Student 101) can be accessed through the QR code below.

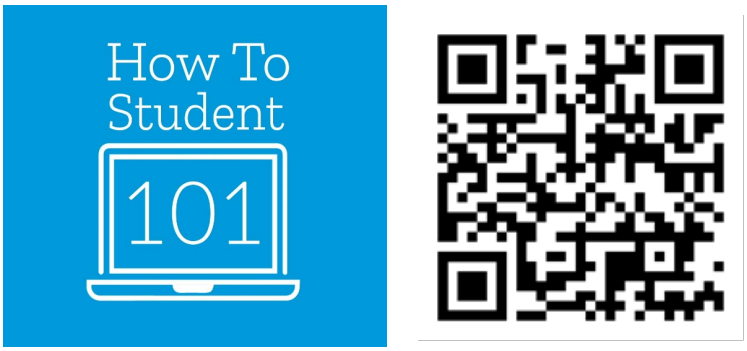

Figure 3: QR code link to example video message to the students

This element of the course was found to be an overwhelming success. Students reported to their teaching assistants that these videos made them more willing to turn on their cameras and interact during the weekly instructions sessions. Seeing the teaching assistants care about their well-being and open up with their own experiences lowered the barrier for students to also share. This also influenced the format of these weekly instructions where the first half hour of the sessions became dedicated to allowing students simply to talk about how they were doing and sharing their experiances.

4.4 Confronting Unexpected Issues

Astronauts are often confronted with unexpected issues that they have to solve with a limited set of resources. This is is best exemplified with one of many challenges on the Apollo 13 mission where astronauts were confronted with making a cube-shaped air filter from the lunar module compatible with the crew module's air filtration system

that required cylindrical-shaped air filters, using only the items available onboard. Rather than expending energy complaining and being upset about problems that arise, astronauts have to be disciplined and creative in coming up with real solutions. It is this attitude we wanted to tap into within our students given the high likelihood for difficulties arising during the course.

To instill this attitude, the approach was two-fold. First, it was important to frame the role of students and staff in the course. The elite astronaut analogy served this purpose well. We reminded students of the significant challenges they already overcame to get accepted into such a competitive programme and that their acceptance was a sign that we believed they had what it took to succeed. Conversely, the teaching staff were compared to mission control. There to direct, assist, and help in ways that they could, but ultimately not able to see first hand the challenges the astronauts were experiencing along their journey. Second, with this framing in place, the importance of transparency and communication was explained. Students were given the opportunity to provide feedback throughout the quarter with open polls each week focusing on study success, student well-being, and providing an opportunity to communicate tips and strategies in addition to challenges. The teaching staff took class time to reflect on the results of these polls during class time. Major challenges the students were facing were acknowledged. Strategies to cope with or overcome the difficulties were discussed. The anonymous responses to the polls were open published in the learning management system so that students could see the responses of the other students and find some solace in discovering they were not alone in their struggles. This was further reinforced by the teaching staff also being open during lectures about their own struggles and challenges being faced on their side of the situation.

An example of one of the weekly open polls given to students is shown in Figure 4. The response rate on such polls was unexpectedly high. The students seemed to enjoy the opportunity to share their thoughts and appreciated the time taken by the staff to reflect on them. Engagement between students in the course discussion boards was also higher than in previous years.

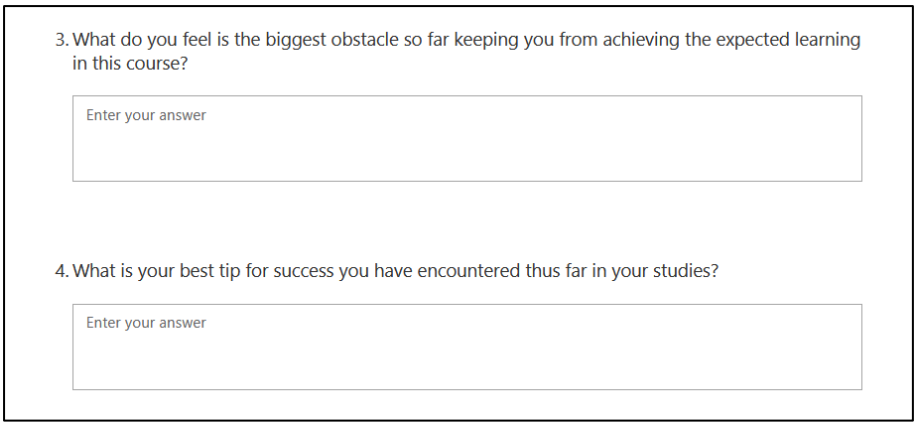

Figure 4: Example open poll for students

The success of this strategy in the course is best exemplified by one of the biggest challenges faced in the course. During the final exam for the course, which was administered online using the *ANS* digital exam/assignment environment, the exam server unexpectedly crashed in the last halfhour of the exam. Understandably, students initially panicked. The course team had organized an Microsoft Teams channel that could be used in case difficulties were encountered during an exam. The channel was initially flooded with panicked messages from students. After making an initial announcement that the staff were aware of the issue and investigating it, we were happy to see several students step in and help manage the channel to make sure our announcements and the important information within them were not lost in a flood of panicked messages. They reminded other students to keep calm and to trust that the teaching staff would be fair in how they dealt with this mishap. The server was restored after 15 minutes, and students were allowed to resume their exam with an extra 20 minutes added to their exam time. In the course reviews, we were pleasantly surprised to see students identifying that indeed this event caused a lot of stress for the students, but that they were satisfied with how the teaching staff dealt with it.

4.5 Having Fun with the Theme

One of the main reasons for making an analogy between a human space mission to Mars and the pandemic online education was student motivation. One factor that should not be overlooked in this is the role of fun in motivation (both for the teachers and the students)! In line with this, the course team added two elements to the course simply to add some fun to the situation.

The first element was the use of storytelling in presenting relevant problems to the students. The analogy of a mission to Mars created a great storyline in which relevant problems for the course could be embedded in a playful manner. The role of the students as elite astronauts on their way to Mars was personified by animated characters that encountered problems that had to be solved to save their mission (see video links in Figure 5). The backstories to these problems was setup in a way that personified the attitude described in the previous section and included several Easter Eggs in terms of subtle references to various aspects of university life. The response to the problems was overwhelming. Rather than simply solving the calculation set out for them in the videos, students engaged with the context and discussed other structural alternatives that could possibly meet the context of the problem.

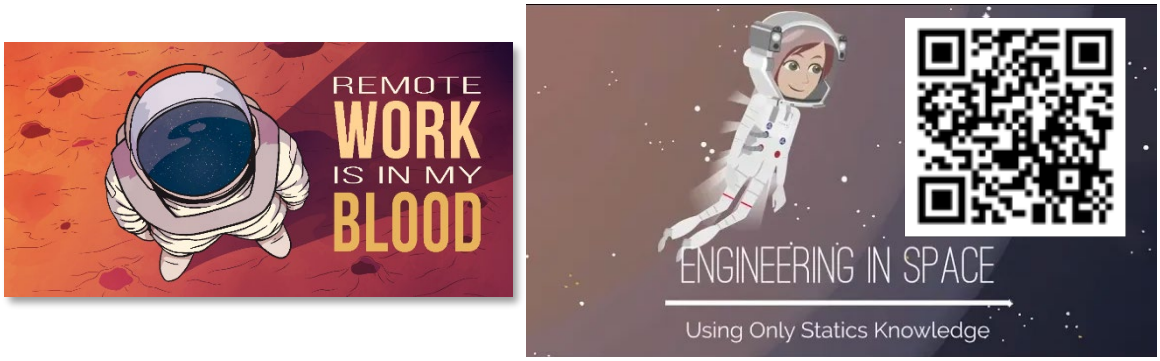

Figure 5: Computer decal mission patch (left) and example spaced-themed statics problem (right).

The second element included in the course for fun was a physical mission patch, in the form of a sticker, that was sent to each of the students (see Figure 5). These stickers captured the analogy of the human spaceflight to Mars and the challenge of remote learning in the form of a badge that students could place on their laptop computers.

5 CRITICAL REFLECTION AND CONCLUSIONS

The authors wanted to share their experiences and efforts with teaching and introductory mechanics course to first year students during the COVID-19 pandemic. However, it should be recognized that what is presented is not a thoroughly planned out academic study. Indeed, although the overall concept of the human mission to Mars analogy was conceived before the course began, many of the elements described evolved over the duration of the course or were completely serendipidous. For example, the story-based Engineering in Space problems previously presented were not planned. They were born out of one of the teachers simply experimenting with a creative outlet to cope with his own stress and anxiety brought about by the pandemic situation. As a result, it does not feel appropriate to over-analyze course statistics or treat any of the outcomes as if it was a planned academic study.

That being said, the authors would like to highlight two key points of reflection. First, is on the importance of empathy and cooperation in the learning process. The major difference between teaching this course before and during the pandemic was not the remote learning aspect, but the added focus on well-being and how students were getting on. This reflection may be biased by the fact that both teachers had had significant online teaching experience prior to the pandemic; however the outcome remains true. Despite the greater distance between students and teachers, a greater awareness of students as people rather than student numbers permeated the entire course. It is hoped that this element of teaching during the pandemic can be maintained after this period of remote teaching ends. Secondly, placing time and energy into these aspects of the learning process seem to pay off. Despite the greater set of challenges students were faced with in remote learning, the performance by the students did not suffer. The passing rate was on par with past

years the course was delivered on-campus. Feedback from students on the course was also more positive and/or constructive than typically received in previous years.

It is the authors' hope that other teachers have had similar experiences over this period of pandemic education and that it will have a transformative effect on the delivery of education following the pandemic. Education more focused on student well-being, empathy, and student-teacher cooperation.

6 ACKNOLEDGMENTS

Special thanks goes to the teaching assistants Sybren Bootsma, Maria Seoane Álvarez, Pieter de Lange, Sara Sequeira Raposeiro, Nathan van 't Hof, Ericka Martin, Megan Segeren, Maximilian Meijkamp, Lukas Bajarūnas, and Momo Powis. Without their help, it would have been impossible to manage the course and provide the students with the level of connection to the faculty and to the greater student population during this trying educational period.

REFERENCES

[1] C. Heinicke, L. Poulet, J. Dunn, and A. Meier, "Crew self-organization and group-living habits during three autonomous, long-duration Mars analog missions," *Acta Astronaut.*, vol. 182, pp. 160–178, 2021, doi: 10/gjtj6q.

[2] L. A. Palinkas, "Psychosocial issues in long-term space flight: overview.," *Gravitational Space Biol. Bull. Publ. Am. Soc. Gravitational Space Biol.*, vol. 14, no. 2, pp. 25–33, 2001.

[3] N. Salamon, J. M. Grimm, J. M. Horack, and E. K. Newton, "Application of virtual reality for crew mental health in extended-duration space missions," *Acta Astronaut.*, vol. 146, pp. 117–122, 2018, doi: 10/gdmhnm.

[4] A. Degani and E. L. Wiener, "Human Factors of Flight-Deck Checklists: The Normal Checklist," p. 70.