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The Corona Research Super Project: A Virtual Transdisciplinary Research Project

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ABSTRACT

During the COVID-19 pandemic, laboratory research was not possible in different educational programs at Delft University of Technology and Erasmus University Medical Center due to the taken measures. Therefore, a team of faculty from both institutions developed an alternative transdisciplinary research group project that was fully performed online. The overall project was named the Corona Research Super Project. This project provided an opportunity for students to fulfil the requirements for their degree while complying with the guidelines of the University, Medical Center, and government. It also gave them an opportunity to participate in something that felt meaningful during a stressful time since all sub-projects contributed to developing knowledge on the current COVID-19 pandemic. This article describes the process of setting up this educational project, the resources provided to the students, and the format of transdisciplinary work. Furthermore, it also provides a theoretical view on how to think about research projects when you cannot be side by side in a laboratory and how to make this into meaningful research education. By sharing our experience of setting up this program in unprecedented times and providing a format, we hope that other universities will use this approach to develop comparable transdisciplinary educational programs. We believe that these sorts of programs are essential for in depth transdisciplinary training of scientists of the future.

Introduction

The COVID-19 pandemic affected all layers of society, including students in science and technology. In the Nanobiology program, a joint degree program of the Delft University of Technology (TU Delft) and the Erasmus University Medical Center (Erasmus MC) in the Netherlands, students often perform laboratory-based experiments as an independent academic research project to complete their bachelor or master's degree. These students often depend on laboratory facilities to perform experiments.

As a result of the lockdown mandated by the Dutch government and subsequent policies instated by TU Delft and Erasmus MC, many students in Nanobiology and other programs were unable to continue and finalize their planned research projects. This led our team of faculty and staff to quickly develop an alternative educational option, which served to provide an opportunity for these students to fulfil the requirements for their degree and address the Corona crisis. The project, named the "Corona Research Super Project" (CRSP), was designed based on several guiding principles: inclusion, flexibility, innovation, and leverage of existing expertise and structures in light of inter- and transdisciplinary learning. From an organizational point of view, we had three aims and questions: (1) Could we quickly organize a cross-university (including multiple departments and study programs) research project to address an important question and avoid study delays for students? (2) Could we provide a meaningful online/in silico research experience for students that would let them acquire new academic skills and stimulate full engagement? and (3) Could we generate useful outcomes that contribute to scientific knowledge?

We aimed to create an impactful program that would be substantial, both for the participants and for society in general. We knew many people in other parts of the universities were feeling somewhat at a loss based on their projects suddenly being stopped. Therefore, from the beginning, we decided to make the project open to anyone who wanted to participate.

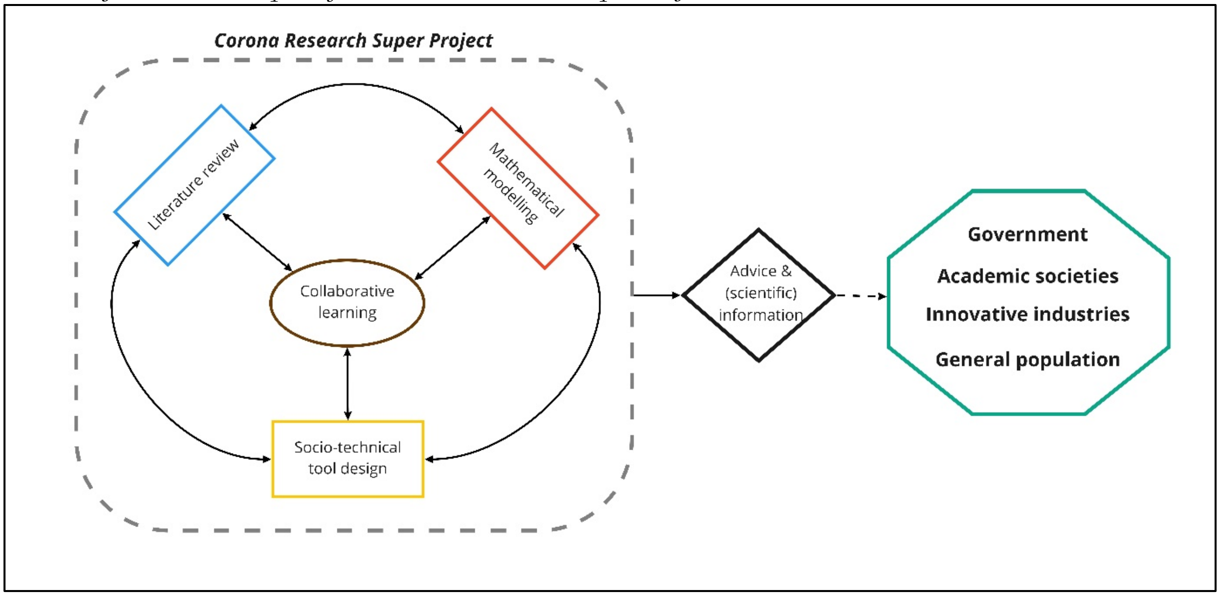
Project Development

Development of the educational plan was started in a brainstorm meeting in which we decided to make the project cross disciplinary and open to all study programs at the two universities. Doctoral students and postdocs were able to join as participants or junior supervisors. No selection criteria were applied; the guiding principle was that all interested and motivated students were welcome. We asked students to participate for a minimum of four weeks with a minimum contribution of eight hours per week. Students could independently determine their weekly contribution in terms of hours, based on the requirements they needed to meet for their specific educational program.

The educational organization was divided into three parts: student research, faculty mentors, and logistics. All three parts started simultaneously, allowed the organization to develop quickly. Within four weeks of the initial meeting, students enrolled in groups and research officially started.

The brainstorm sessions also yielded three main research topics, which were all interconnected and related to the COVID-19 outbreak and based on the relevance to and expertise of the recruited supervisors (Figure 1). To inform students and faculty members of the opportunity to join this transdisciplinary effort, these topics along with an application form were shared on the learning management platform of the Nanobiology program and via other appropriate communication channels such as faculty newsletters and emails to graduate supervisors, study associations, and adjacent education programs.

Figure 1
Three Major Research Topics of the Corona Research Super Project



Participants signed up with a simple online form, which included their preferred topic, program of study, personal learning goals, and expertise they would bring to the project. The participants were from a total of 13 different programs of study or departments, ranging from medical programs to architecture and communications (Table 1). Most students were pursuing a bachelor's degree, and the motivation most quoted for their participation was to contribute to obtaining scientific knowledge on the subject of COVID-19. In total, 60 students were in ten groups over the three main topics with each group was supervised by one or two faculty members from TU Delft and/or Erasmus MC (Table 2).

Table 1
Overview of Participants' Programs, Degrees, and Motivation (Descending Frequency)

Study program or department	Nanobiology Medicine Infection & Immunity Life Science & Technology Communication Design for Innovation Complex Systems Engineering & Management Applied Physics Viroscience Molecular Genetics Molecular Medicine Bionanoscience Pharmacy Architecture
Level	Bachelor Master PhD
Original project type	Volunteer Bachelor thesis Honours program (medicine) Elective Master thesis Internship

Table 2
Overview of the 10 Subtopics Within the Three Main Categories

Main Category	Subtopic
Literature review	Mechanistic differences between influenza and corona viral infections
	Critical review of drugs that can be repurposed to treat COVID-19 and their proposed mechanism of action
	Inventory of vaccines and treatments for COVID-19
	Diagnosis of COVID-19
Mathematical modeling	Stochastic models for COVID-19 disease spread
	Computational models for COVID-19 testing strategies
	Stochastic models for COVID-19 immunity development
	Game theoretical modelling of COVID-19 intra-host evolution
Socio-technical tool design	COVID-19 data search and representation of meaningful data
	Case study and decision tool development to support the develop of future measures to overcome a pandemic crisis

The organizers provided general information to supervisors but allowed each group to decide how best to communicate and work together. During the meetings, students were encouraged to further develop their own research questions within the scope of the proposed topics in their group. All groups, while working separately, were connected and exchanged findings and resources.

The educational organization team of the CRSP consisted of multiple layers. The CRSP director was directly supported by the Nanobiology program coordinator and a teaching assistant. Furthermore, a small group of CRSP supervisors were involved as an advisory committee. This group met each week to discuss organizational aspects. In addition, communication activities were discussed in this meeting with a master's student, who joined the group as a communications intern and had the task to set up the outreach activities of the CRSP.

Communications within as well as between groups and transmission of data and files was facilitated using a SharePoint server which was available for the director and supervisors of the groups. Moreover, every participant in the project had access to a Discord server (discord.com) for exchanging findings and ideas. This approach greatly facilitated communication among all groups, as it was independent of the different learning management platforms used by the various educational programs. A separate email address for the project director was created to facilitate efficient communication with all involved and external interested parties.

Reporting

The different group projects executed a variety of activities, and within groups, contributions of individual students differed. To keep track of progress and ensure a cohesive range of products, each group produced a weekly report. These weekly updates described activities in the past week, challenges that the group faced, and planned directions for further research. In addition, each student maintained a personal logbook (Wick, Decker, Matthes, & Wright, 2013), to account for the requested study credits at the end of the project. Additionally, each week, all group supervisors, the director, and presenting students gathered for a content update. During these virtual meetings, a rotating subset of the project groups presented their current findings and goals for the next weeks. These presentations were followed by feedback discussions during which other groups could provide constructive criticism and possible overlap between the research areas of other groups could be found, thereby increasing opportunities for collaboration between groups. The weekly update meetings also served as an opportunity to communicate organizational information. One of the group supervisors, who chaired each weekly meeting, helped build connections between the research presented by making suggestions about how they could build off each other.

Each group, as part of their final product, was required to write a report describing their complete research process and findings. All reports included a clear description of author contributions. The complete project spanned 12 weeks. Groups submitted their draft reports at the end of the tenth week of research. Three other groups peer-reviewed these reports. The groups exchanged their peer feedback after one week and had a final week to revise and resubmit their final report. The CRSP concluded with an open online symposium, which included presentations from all groups including in-depth discussions in break-out rooms. Furthermore, two experts in the field of Corona research were invited to give a lecture. The symposium served to report the results to the TU Delft and Erasmus MC students, faculty communities, and other interested persons. The students acquired presentation skills and enjoyed the sense of group achievement. Several of the groups were also developing manuscripts to be submitted to scientific journals based on the work they did during the project.

Study Credits

Since participants joined from various educational programs, acquiring study credits for the CRSP was kept flexible. Not all students were getting the same amount of study credits, and the negotiation of credits earned was left to the responsibility of the students and their specific program. This flexibility eliminated the need to wait for inter-program agreements to be finalized. Students could enroll in a Nanobiology independent research elective (one for bachelor's level students and one for master's level); this course was pass/fail. Study credits were calculated based on the hours spent on the project. Depending on their study program and what requirement they were fulfilling, students might have to write an additional individual report or prepare an individual presentation. Besides obtaining study credits, students could also have joined the project as a volunteer or as part of their honors program.

Challenges of the Project

The main challenge of the CRSP involved optimization of collaboration between groups. Topics and background experience and knowledge varied significantly, and connecting all groups so they could benefit from each other's work was challenging. This coincided with a lack of interaction between students working on different topics. During the weekly meetings, participants of non-presenting groups did not always attend, hence the degree of interaction varied accordingly. This issue was partially solved by launching the Discord server, which helped to improve interactions and communication. Minor challenges included recruiting faculty with relevant experience at the beginning of the project, finding the best ways of communication of information to the supervisors and participants, and defining the grading options. These challenges were overcome during the CRSP.

Transdisciplinary Learning

In these contemporary times, higher education in general and in the context of COVID-19 specifically faces a profound challenge, characterized by an integrated, boundary less, ever evolving world. The students in the CRSP learned that the current separation of disciplinary content no longer held to understand or to design solutions for complex issues such as COVID-19. Hence, instead of viewing disciplines as blocks of knowledge that defined what to know and what to do, students and lecturers in the CRSP specifically were encouraged to see disciplines as opportunities to explore different ways of thinking (McGregor, 2017). The collaborative network the students and supervisors of the CRSP were working in is a so-called community of learning.

McGregor wrote that supporters of transdisciplinary learning assume that learning occurs concurrently within and outside a person, individually and collectively (i.e., community of practice). For each participant, their view of the problem, their chosen approach, and their possible solutions might have shifted, potentially leading to new ideas and concepts as the transdisciplinary learning cycle continued. Participants iteratively articulated ideas and suggestions, deliberated them, and took action (McGregor, 2017). These kind of learning processes are closely linked to triple loop learning (Romme & van Witteloostuijn, 1999).

The triple loop transdisciplinary learning process is often described in the question: How do we decide to do the right thing? In comparison to single loop learning (*understanding* and *improvement* of the COVID-19 situation as it is) and double loop learning (*improving* and *development* of the situation for COVID-19 through enhancing the students' learning processes), triple loop learning addresses the existential questions students might have. Through the betterment of their learning processes, participants were able to reflect on their underlying assumptions on why certain aspects of mitigation of COVID-19 were or were not important. The latter fosters and furthers the development of conceptual ideas students had and gives them the ability to think about the *transformation* of COVID-19 mitigation. This habit of mind might radically change mitigation of COVID-19 for the future since the underlying assumptions of existing strategies might change. In addition to this deep transdisciplinary learning experience of the students that hopefully feeds into their future adaptive professional life, the development of conceptual and transferable ideas about the dynamic context of uncertain future science and technology development is necessity for robust adaptive mitigation strategies for COVID-19 and the like.

Future of the Project

Several of the important learning aims of the CRSP is the ability to work in an inter- and transdisciplinary group, to be able to communicate specialist knowledge to people from other fields, and to work together to answer complex questions, all while working remotely. We are developing this project into a permanent educational program in which students from different programs of study will work together in interdisciplinary groups on highly relevant biomedical research questions that require a transdisciplinary approach. If the societal circumstances permit, these projects may also include a wet lab component. This format will be developed into a full-time, four-month project for students at the end of their bachelor's studies or the beginning of their master's studies.

Conclusion

The aims of this project were to (1) quickly organize a project to serve as substitute for cancelled student research programs, (2) provide a meaningful opportunity for students to gain skills and experience in collaboration, and (3) contribute to scientific knowledge about COVID-19. By setting this project up as an open program for all interested persons, a variety of students and supervisors joined the project, allowing for a multidisciplinary approach to answering COVID-19 related research questions. The use of available infrastructure in the organizations (e.g., SharePoint and Discord) allowed the project to develop quickly while maintaining flexibility. Results of the project were shared at a symposium. The inter- and transdisciplinary environment brought students from many different programs and levels together, which improved collaborative skills. The manuscripts being developed by several teams represent a scientific contribution as a result. The many lessons learned in through the CRSP will inform future projects.

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