Open Education **Stimulation Fund**

Projects completed in **2023**

TU Delft

Colofon

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Changing Our Teaching with Open Education at TU Delft

TU Delft has been a frontrunner of open education ever since the start of OpenCourseWare in 2006. Since then, our university has been offering the world free access to an expanding variety of course content online, created by our teachers.

What started as a means of sharing course content openly has grown and transformed into a larger movement in education. In 2020, the year that marked the start of our Open Science Programme, we began working towards incorporating open principles into our campus education as well. This means that we intend to build our BSc and MSc courses more around Open Educational Resources (OER), that we incorporate open principles into our pedagogical approach, and that we adopt open systems that facilitate this transformation.

As a university, we are still actively working to realise this transformation. Many of our teaching staff have been dedicated to sharing their work as TU Delft Open Textbooks and knowledge clips, and we also have active teacher communities on our campus that collaborate on the use, creation, and dissemination of OER. As the Executive Board of TU Delft, we believe that the university has an important societal task to work with knowledge openly both in our research and our educational activities and to be transparent about what kind of engineers we deliver to society and how we educate them. That is why open education is becoming an increasingly central aspect of how we teach and how we organise our courses and our bachelor and master programmes.

We believe that the most important change-makers in education are teachers and students. In the past years I have seen a great number of initiatives from teachers incorporating open principles into their education at TU Delft. To keep teachers closely involved in determining the course of open education at our university and to ensure that more teachers are given the space and opportunity to put their open education related ideas into practice in our campus education, the Open Education Stimulation Fund was established. The first cohort of 11 projects ran in 2023, and I am very happy with the results that are coming out of these projects. I see this as great step forward in making open education a standard teaching practice at TU Delft. And as I understand from the Open Science Programme team, 13 new open education projects started last month. That means that even more teachers are identifying with the value of open education.

Congratulations to all members of the Open Education Stimulation Fund projects for delivering your projects. On behalf of the Executive Board of TU Delft,

Prof.dr. Rob F. Mudde
Vice-rector Magnificus/Vice-President Education
for the Executive Board of TU Delft

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Setting up the
Open Education Stimulation Fund

In 2022, the TU Delft Open Science Programme had passed its halfway point.

The main results of its open education project revolved around developing a technical and support infrastructure for creating, publishing and reusing Open Educational Resources (OER) in our campus education: an institutional policy for publishing Open Educational Resources, an open textbook publishing service, and a copyright support desk. These are crucial elements of a well-functioning open education ecosystem, yet it is just as important that teaching staff feels the pertinence of 'open' in their own teaching. Having worked with various grassroots communities centred around open education, we saw the benefits of teachers initiating their own educational innovation projects. To stimulate this further, we decided to facilitate more grassroots initiatives around open education. That is how we began setting up what is now the Open Education Stimulation Fund (OESF).

Broader goals

We considered increasing teachers' ownership around open education one of the main goals, and thus aimed to give space to our teaching staff to formulate their own interpretation of how open education can enhance their education. We therefore defined the broader goals of the call as:

- Publishing innovative self-made teaching materials, such as interactive open textbooks or open educational resources.
- Educating teaching staff about (the benefits of) finding, selecting, and using already existing open educational resources.
- The development and implementation of innovative open educational practices that involve students in the development of OER.
- Documentation, publication, dissemination and/or upscaling of already existing innovative open educational practices.

Project criteria

In order to ensure the feasibility of projects, the project term was set to one year, with a maximum possible funding of EUR 20,000. We considered these conditions to provide a good balance to formulate ambitious projects that are feasible in the period of one year.

In ensuring the successful implementation of the projects, five evaluation criteria were defined:

1. Relevance - Does the project address an existing problem?
2. Originality - Does the project propose a new way of dealing with the defined problem?
3. Feasibility - Are the goals of the project achievable within the financial and time limitations of the call?
4. Impact - How many teachers and/or students are served by the project? Does the project also serve people outside the faculty and/or TU Delft?
5. Collaboration - Is there collaboration between faculties? Or between students and teachers?

OESF journey

The selection process was carried out by a review committee established specifically for this call, composed of the members of the Open Education Advisory Board, who assessed the proposals according to these five criteria. We received 25 submissions, from which the review committee selected 11 for funding, for a total of EUR 190,000. We were thrilled and amazed to see so many good projects coming out of the call.

At the kick-off session, gathering members from each of the projects, it soon became clear that we began the OESF journey with an amazing group of ambitious and inspiring teachers. Throughout the project period we were ready to provide support and guidance to the projects whenever needed. At the same time, the creative and professional project teams were largely self-sufficient, and indeed they lived up to the promise of taking ownership. We are also very thankful to our communications colleagues, Ymke Bresser, Emilie Yane-Lopes, and Bianca Witmer, who played a pivotal role in disseminating the successes and outcomes to a wider audience so that many can learn about the great results of the projects. And the culmination of a great collaboration between the project members, communication colleagues, and ourselves is the realisation of the Open Education Stimulation Fund Symposium.

We would like this yearbook for the Open Education Stimulation Fund to be a publication that the project leaders can refer to when they show their excellence in education. We also hope that it will showcase the diversity of open education projects that make TU Delft stand out as an institution that greatly values open education. In addition, we are glad to see that the momentum does not stop here. The second cohort of the Fund has just started with even more projects: 13 out of 29 proposals were accepted this year. We consider this as evidence that open education is increasingly becoming the standard in the education of TU Delft, and that makes us very proud.

Congratulations to all the project leaders for delivering their results!

Dr. Michiel de Jong
Coordinator for Open Education
TU Delft Library

Marcell Várkonyi
Open Education Specialist
TU Delft Library

Open, Interactive, Autonomous
Learning materials for computational design

Project title: Computational design for designers - Rhino Grasshopper based tutorials and knowledge base

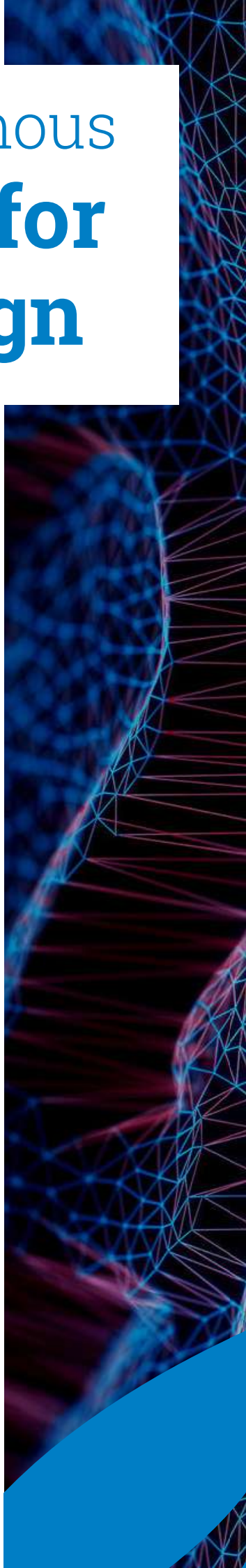
Teaching a group of students with diverse levels and technical backgrounds can be complicated. That was just one of the challenges that inspired Assistant Professor Willemijn Elkhuizen and Associate Professor Wolf Song to develop new educational materials for their Computational Design courses at the Faculty of Industrial Design Engineering (IDE). By creating an open interactive textbook, students now have the opportunity for an autonomous, self-paced, and customised learning experience.

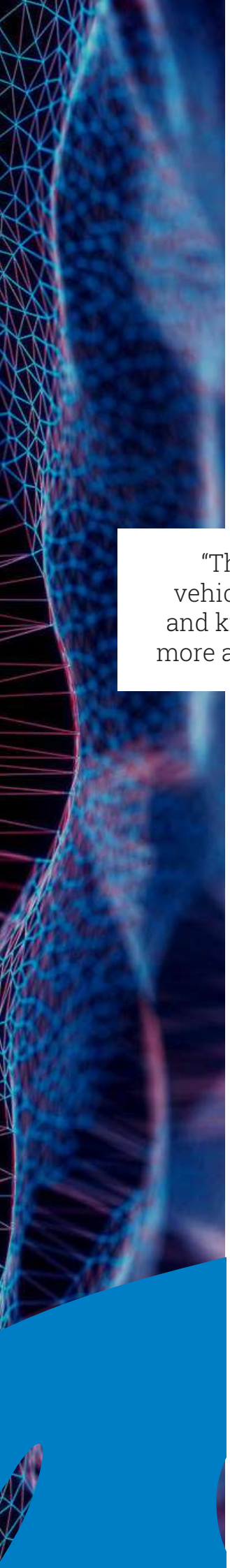
Starting point

In the Advanced Prototyping minor at IDE, one of the courses Elkhuizen teaches is Computational Design. Students learn how to use 3D modelling, combining computational power with design techniques, to design things like a personalised fit bicycle helmet, for example. One of the tools they use, Rhino Grasshopper, has always been taught in a traditional setting with a teacher in front of the class, explains Elkhuizen. “That has some downsides because I have a very diverse group in my minor - some from industrial design engineering and others from all kinds of technical backgrounds as well,” she says. “So one of the issues that we’ve run into is that for some it goes too slow, for others too fast.” There were also requests from students wanting to learn outside of the context of her course. In addition, currently the demand for this course is higher than the number of students they can facilitate.

With a similar course at the master’s level, Song teaches the topic at a more advanced level. Yet he faced the same challenges in teaching to a diverse group, some of whom needed to learn the programme starting from zero. Such was the starting point that inspired the pair to give students a more autonomous, self-paced learning experience.

“Our vision for this book is that it can be a place where we can transfer all of the cool things that students do to the next generation.”





Open and accessible

Combining the lessons from both classes, Song and Elkhuizen created an open, interactive textbook using the Jupyter Book platform. The Open Education Stimulation Fund enabled them to create recorded video lectures and add more educational material such as exercises and tutorials. The Jupyter Book platform facilitates text, videos, downloadable files and can even incorporate code. “When students develop pieces of code during graduation projects, normally that gets lost,” says Elkhuizen. “Our vision for this book is that it can be a place where we can transfer all of the cool things that students do to the next generation.”

They can also include content developed through research by colleagues, such as specific scripts to prepare a file for a 3D printer. The Jupyter Book platform is a vehicle to bring a variety of material and knowledge to students in a much more accessible and personalised way. Elkhuizen explains that they structured the material so that it can be followed without supervision if desired, while also making advanced materials available to bachelor’s students who want more of a challenge.

“The Jupyter Book platform is a vehicle to bring a variety of material and knowledge to students in a much more accessible and personalised way.”

Positive feedback

Although there is still some work to be done on the project, Elkhuizen said the feedback so far has been very positive. They launched a preliminary version of the book with students this year as a trial and were pleasantly surprised with the results. The course evaluations were similar to the prior year as were the outcomes they saw, showing them that the format works. The team is still working on getting copyright permission to use content created by former students, which is the final step needed to publish the fully open final product, which is expected this March.

Going forward, the team also plans to explore opportunities for collaborations to expand to other technical domains that use similar applications, like Architecture and Civil Engineering. But for now, Elkhuizen says: “I am proud that from just having this idea and initiating it that we already got so far, and it has been so well received by the students. I am also proud that I carved out the time to address this latent need because there is a priority for this kind of material.”

Contributors:

Willemijn Elkhuizen, Assistant Professor, Industrial Design Engineering faculty | Anne van der Dool, Teacher, Industrial Design Engineering faculty | Niels van Silfhout, Teaching Assistant, Industrial Design Engineering faculty | Sander Minnoye, Teacher, Industrial Design Engineering faculty | Wolf Song, Associate Professor, Industrial Design Engineering faculty

Decolonising
Data Science Education

Project title: Decolonising Data Science Education

Existing data science educational material represents a narrow view that might unfairly privilege certain demographics while excluding other identities and issues. Starting with their own course, Associate Professor Trivik Verma and Assistant Professor Juliana Goncalves aim to decolonise data science education. They created an open interactive textbook that critically examines the way analysis and design impacts or perpetuates issues of inclusion, inequality, participation, power, and positionality. They also developed a formal approach that can be used by others.

Unequal and sensitive subject

Understanding the inequalities and vulnerability of communities in urban spaces around the world is central to the research that Goncalves and Verma do. From Brazil and India respectively, they see a lot of inequalities between countries in the Global North and Global South. However, there is very little data available to study the impacts of these inequalities in the Global South. “It’s difficult to digest that we are looking at all of this data without any reflection on what’s going on and thinking of data technology as the ultimate equaliser and an objective tool to deliver solutions,” says Verma. “Data is also used to cause injustices in society.” Technology alone can’t solve the world’s problems. He says the solutions are found in understanding how politics, capital, and social realities intersect with technology.

Addressing the consequences of a colonial past and the role of education therein can be a sensitive topic in a technical university such as TU Delft,

says Goncalves. “I think we have to engage with those debates in a very academic way as well.” Verma and Goncalves run the Centre for Urban Science & Policy together at TU Delft, where they see a lot of resonance on their ideas from students. “We engage with them and ask their opinions and they are often even more critical than we are,” says Goncalves. “They also see these problems and expect us to address them, but we would like to work together with them. I think they must be at the forefront of the change in education.”

Contributors:

Trivik Verma, Assistant Professor, Technology, Policy and Management faculty | Juliana Gonçalves, Assistant Professor, Architecture and the Built Environment faculty

Towards decolonisation

The first stage of their project involved an ethnographic analysis of the TU Delft community, conducted by Tian Qing Yen, a communications master's student at the university. "The idea was to study how our community perceived themselves and how that might be related to our own identities and positionality in the world," says Verma. "We learned quite a bit about who our colleagues are, what they stand for, what they feel, and how they want to engage with the subject of data science and machine learning."

> "We were already using language from concepts of intersectionality, feminist theory, critical race theory, critical science itself, and eventually realised that we should take a more pedagogical and academic approach to try and do that in a formal way."

Goncalves and Verma then started the process of decolonising a course they teach together called Spatial Data Science. "We were already using language from concepts of intersectionality, feminist theory, critical race theory, critical science itself, and eventually realised that we should take a more pedagogical and academic approach to try and do that in a formal way," says Verma. They wanted to create a process that would be helpful for colleagues who might be thinking about decolonising other courses. The pair developed a formal approach to do that and wrote an article about it, which they hope to publish later this year. In addition, they produced an open interactive textbook which is currently in use for their course.

Critical impact

In addition to funding that enabled them to hire people, the project provided validation for the team. "It gave us reassurance that we are doing something that is valuable," says Goncalves. "To me, that was a more symbolic value than the funding itself." And they are getting a lot of positive feedback about their course material from international and Dutch students, both at TU Delft and outside. "It has created a positive space for the student community to feel like they are getting what they wanted from this education," says Verma. "I'm proud that our students are independent in thinking about these critical issues and that they challenge us and sometimes surprise us with what they can accomplish."

"The project provided validation for the team. It gave us reassurance that we are doing something that is valuable."

During the project, a new idea emerged about creating a workshop for people to share insights and later write manifestos on rethinking higher education. The plan is to publish the collection through TU Delft OPEN Publishing. "It's a continuation of the project by creating a community of people that are critically engaged in rethinking higher education from different angles."

Helping students shape their own **Learning experience with open education materials**

Project title: Structured story for the video's for the course "Introductie Elektriciteit en Magnetisme"

Many students these days want more flexibility and autonomy when it comes to their studies. Added to that, the COVID pandemic amplified the need to make educational materials available online. At that time, Associate Professors Wim Bouwman and Jacob Hoogenboom scrambled to record around 100 lecture videos for their Electricity and Magnetism course at the Faculty of Applied Sciences. To improve the overview and connections within the series of videos and make the materials more accessible, they created an interactive collection using Jupyter book that provides structure and gives students the ability to shape their own learning experience.

> "It's an easy way to present a whole variety of content types including videos, mathematical equations, and normal text, and it comes out nicely on the computer screen."

Structure with a story

Even before COVID, Bouwman and Hoogenboom started recording videos as a blended learning project to address the diversity of the student population and support various learning issues. But when the pandemic hit, they sped up their efforts to create a sequence of video lectures fully covering their course contents. They noted that the overview of videos on their YouTube channel lacked context and did not show relations between the videos. To address that, the pair chose to create a Jupyter book for their course materials, putting them together chapter by chapter with a story format. This structured format makes it easy to follow, navigate, and maintain while students can also easily give feedback for further improvement. "It's an easy way to present a whole variety of content types including videos, mathematical equations, and normal text, and it comes out nicely on the computer screen," says Bouwman. Unlike the commonly used LaTeX, which generates material in pdf format, the layout with Jupyter books is always adapting itself. That means it's easy to access on both small and large screens.

Project support

The Open Education Stimulation Fund award made it possible for the team to realise their project in different ways, say Bouwman and Hoogenboom. Choosing to publish as a Jupyter book was new territory for them, but the Open Education team at the TU Delft Library helped with practical things like getting it on the right servers, maintaining it, and getting the right links for their updated videos. Bouwman notes that the award also enabled them to use teaching assistants to do administrative tasks which can take quite a bit of time. In addition, the structure and timeline of the project motivated them and helped them get clear on what they needed to deliver.

> "Getting in touch with other people doing similar projects stimulates connections."

Hoogenboom agrees that the support structure was very important. With access to a more advanced recording studio, they were able to produce some new video content like demonstration videos by lecturer Ron Haaksman and they upgraded some existing videos that they found to have insufficient quality. But it was more than that. "Getting in touch with other people doing similar projects stimulates connections," he says. "And continuing the work that we had already started by turning it into a Jupyter book brings more attention and helps make people aware of what is possible."

Adapting and expanding access

The Jupyter book has helped the pair adapt their teaching and allowed them to better consider individual needs in a classroom of 250 students. In addition to plenary lectures, students can work through the videos and exercises at their own pace with help from student assistants, or they can choose to work from home. "A large majority of first year students still live with their parents, which can be far from campus. They can choose to come to campus when they really need support," says Hoogenboom. "We've received a lot of feedback from students that this way of teaching helps them." The open access content that they have created not only improves the learning experience for their students, but the course is now widely available. Other universities can benefit, says Bouwman, particularly Dutch "hogescholen", or universities of applied sciences. "We have created a nice, easy to access book with a good overview, where you can find all the videos and material," he says. "Jacob and I are both positive, enthusiastic teachers and I think you can see that in the book. It really reflects us as teachers." For Hoogenboom, the impact is in allowing students to make their own choice in how they learn and at what pace they learn. "That freedom to shape it to your own needs and your own learning style is very important. And so far, the feedback from students is very positive."

"That freedom to shape it to your own needs and your own learning style is very important. And so far, the feedback from students is very positive."

Contributors:

Wim Bouwman, Associate Professor, Applied Sciences faculty | Jacob Hoogenboom, Associate Professor, Applied Sciences faculty | Ron Haaksman, Lecturer, Applied Sciences faculty

An interactive take on **Learning Operations Research**

Project title: From theORY to application: learning to optimize with Operations Research in an interactive way

Operations Research takes real-world problems, approximates them with a mathematical model, and then uses an algorithm to find good or even optimal solutions – given certain constraints. Straightforward as this may sound, some students struggle with making the translation from real-life to an abstract set of equations and the other way around.

The team with Alessandro Bombelli, Assistant Professor at the Aerospace Engineering Faculty, set out to create an engaging and fun way to help students get their head around this. “Operations research is being taught at various faculties across TU Delft – first in general terms and then applied to specific domains,” he says. “The underlying principles are the same. We wanted to develop something that would be useful for all students, regardless of the faculty. And to make it open source.”

> “These games do not specifically delve into the underlying math, but it helps students to engage with Operations Research in a fun way.”

Tangible games

Most of the funding they received went to developing various (mostly physical) games. “These games do not specifically delve into the underlying math, but it helps students to engage with Operations Research in a fun way,” Bombelli says. “Take the classic knapsack problem, for example, in which one must fill a backpack with items of diverse value and weight, aiming for maximum value within a weight constraint. We turned this into a card game involving a warrior that needs to defeat some monsters if he wants to stay alive.” Development was mostly carried out by co-applicant Doris Boschma, of the Gamelab at the Faculty of Technology, Policy and Management, which is specialized in developing games and simulations with a research perspective. The games are available to anyone in a *print and play* format.

Contributors:

Alessandro Bombelli, Lecturer, Aerospace Engineering faculty | Bilge Atasoy, Associate Professor, Mechanical, Maritime and Materials Engineering faculty | Stefano Fazi, Assistant Professor, Technology, Policy and Management faculty | Doris Boschma, Project manager at Gamelab, Technology, Policy and Management faculty

Outside the box

The team has played and refined the games together with colleagues and students, getting good feedback – to make the higher levels a bit more challenging, for example. Alessandro also gave a workshop on the games at the TU Delft Education Day, gathering more feedback. “One of the attendees was a lecturer from Computer Science, teaching Operation Research from a more algorithm design perspective,” Bombelli says. “He played the game with his students, with me attending. We’re very proud for a project outcome to have left our developers’ realm, even before project completion.”

He may give another workshop at the TU Delft Teaching Academy and is planning an official release and perhaps some promotion at project completion. “The cherry would be for it to be picked up by people from the other side of the world too and get an email it helped them.”

Book and code

Another output of the project is an open-source textbook which is intended to be more engaging than available resources, both in content and graphics. “It explains certain Operations Research concepts in a way that we deem more understandable,” Bombelli says. “We also made great effort, and take pride in, the quality of the figures and layout of the book. It is not the first such resource, but it is ours: we can control, change, and continually improve it. Again, I can’t imagine a better reward than having people all over the world use it.”

The soon to be published book will be accompanied by source code examples, showing the translation of real-world problems into the realm of Operations Research. “It has been a joint effort with my other two co-applicants (together with Doris), colleagues and friends Bilge Atasoy from Mechanical Engineering and Stefano Fazi from Technology, Policy, and Management,” Bombelli says. “Our shared expertise and effort made it possible to complete a first version of the book within a very tight schedule. And the funding allowed us to hire a teaching assistant who helped with gathering, cleaning up, and formatting the code examples.”

Follow suit

Funding by the Open Education Stimulation Fund not only helped to pay for development support, it also provided deadlines, thus creating a time-frame in which content had to be delivered. “Without their support, it might have remained an idea in the back of our heads and never have materialized,” Bombelli says. “Now we have an open-source textbook and three games.”

Despite the sizeable time commitment, he found the project manageable and a lot of fun to do. He would certainly recommend other lecturers to follow suit. “It is so very different from a textbook or video-lecture. Even if the students do not find it super useful, it will make the course more engaging. And you get to meet useful colleagues outside of your inner circle. For me, it has been very interesting getting to collaborate with the Gamelab.”

Personalised, automated **Learning environment** helps students qualify for design classes

Project title: Quiz generator for interactive MOOC

When students come from other universities for a master's at TU Delft, they arrive with diverse levels of skills and knowledge. The difficult task of ensuring they are prepared to meet the academic requirements could be more efficient with a personalised method. Associate Professor Chris Verhoeven and Principal Educator Anton Montagne developed an application for their Structured Electronics Design course that generates individualised quizzes to create a portfolio of each student's level of knowledge and skills and provide guidance on areas for improvement. Through the project, they created an open website and book that can help prepare new students for design classes and improve their learning experience.

"In the end, each student will have a kind of portfolio where the system tracks what you have and at some point, it can also judge whether your portfolio is good enough for a certain module."

Homologation challenge

Teaching can be quite a challenge when a group of students is not all at the same level. According to Bloom's Taxonomy, there are six levels that allow educators to gauge a learner's progress. And homologation, a process of confirming a student's equivalent knowledge or skills, can be difficult says Verhoeven. "You need to bring the student to a certain level but you rarely get there," he says. "That has to do with the fact that you don't know what the starting point is for the students." While TU Delft bachelor's students have taken the prerequisite courses for the master's programme, students from other universities might need to take some bridging courses. Verhoeven and Montagne thought there must be a better, more efficient homologation method that eliminates the guesswork and ensures a level starting point for new students.

Personalised method

To address the levels of individual students, they wanted to create a tool that could personalise the approach. Instead of working on the software and tool themselves, the pair wanted to focus on the content behind the tool. Using an extensive parameterised database of questions tagged with things like topic, Bloom level (classification of learning level), and type, they launched a website that creates individualised quizzes to frame the student's level of knowledge and skills. Students are then guided through an exploration of self-study where it is needed. It works a bit like a computer adventure game where you need to gain certain skills to survive, explains Verhoeven. A student identifies where they want to go and the system asks questions to determine their skill level, constantly providing feedback along the way. "In the end, each student will have a kind of portfolio where the system tracks what you have and at some point, it can also judge whether your portfolio is good enough for a certain module," says Montagne. It's almost like having a digital study advisor.

Structure that works

It was important to present the material with a logical structure, according to Montagne. "We should be teaching students how to solve complex problems as a group of engineers," he says. "It has to be systematic, keeping track of relations between less and more complex problems." Students should be able to understand something and then build on that going forward. The pair turned their structured material into an open textbook, published through TU Delft OPEN Publishing, and have plans to translate it to an interactive Jupyter book in the future.

> "We get lots of talented students and we manage to make the most of that talent and bring them to the highest level. That makes us the proudest."

Hundreds of students have now gone through their course using these resources, and students are even accessing the website from other parts of the world. Verhoeven and Montagne are amazed at the results so far, receiving positive feedback from those using their resources. "We're happy to see that it works because that's what we're doing it for," says Montagne. "When we see students become mature professional designers, we feel almost like proud parents," notes Verhoeven. "We get lots of talented students and we manage to make the most of that talent and bring them to the highest level. That makes us the proudest, that we can get the students to the max that they can achieve."

Having created much more material, including posters and infographics, Verhoeven and Montagne would love to expand their project, providing even more educational resources for TU Delft students and others.

Contributors:

Chris Verhoeven, Associate Professor, Electrical Engineering Mathematics & Computer Science faculty | Anton Montagne, Principal Educator, Electrical Engineering Mathematics & Computer Science faculty

Sharing PRIME educational tools improves mathematics for engineering students

Project title: Sharing PRIME educational tools for mathematics in engineering

With more than 300 videos, applets and interactive videos spread across multiple platforms, PRIME – the Programme of Innovation in Mathematics Education at TU Delft – needed a better way to organise and share their learning resources. Programme Manager Tom Vroegrijk and Coordinator Beryl van Gelderen spearheaded a project to make their materials easier to find and more accessible, supporting lecturers and improving mathematics education for engineering students at TU Delft and beyond.

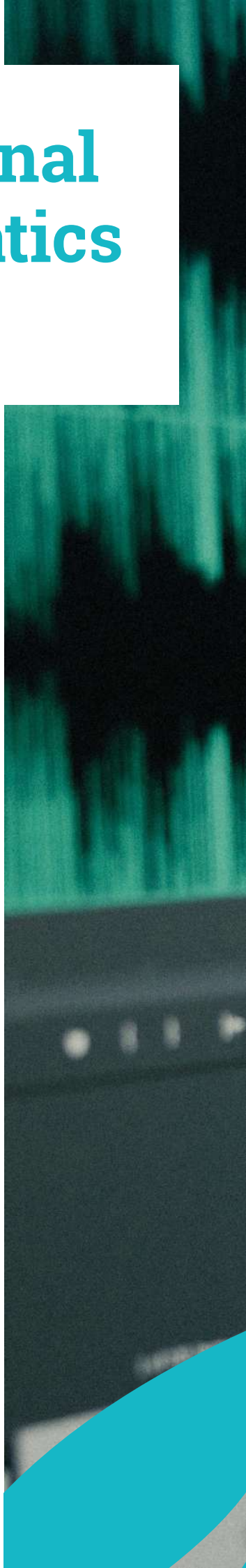
"When we show all of these materials to people, both inside and outside of TU Delft, they are amazed at what we have been able to do because it's quite unique."

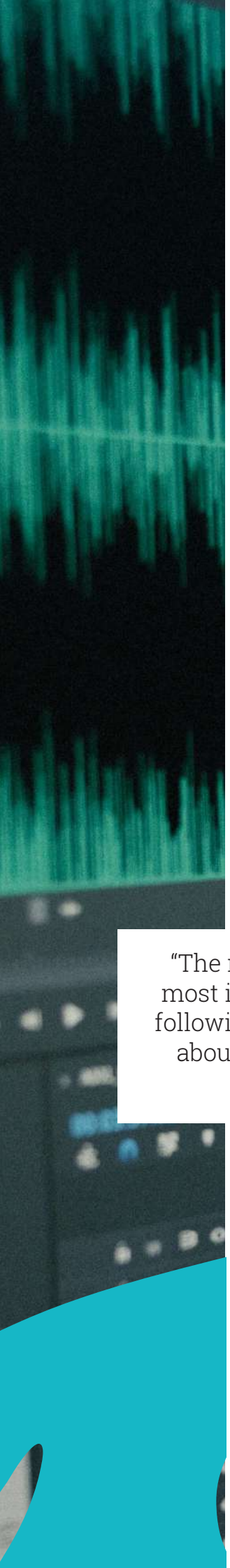
A collection to be shared

Well before this project, mathematics lecturer Vroegrijk notes that PRIME had an open education focus. "Our idea is that lecture materials should be shared openly as much as possible," he says. The team that includes more than 30 lecturers, 4 coordinators, and a lot of student assistants works to design, improve, and organise 45 mathematics courses for interfaculty education.

"Our idea is that lecture materials should be shared openly as much as possible,"

Over the last couple of years, master's student van Gelderen said the group made a lot of educational content but there wasn't a clear overview or consolidated collection. "The content is out there, but it's hard to find," she says. With much of their work focused on creating content, Vroegrijk says they had not done a lot of outreach or officially shared their materials. They needed a way for lecturers to link to the material, making it easier for students to find and use.





Team effort leads to open

The project itself was a collaboration between lecturers and students, each contributing their own expertise. Much of the programming was done by Computer Science student assistants, and Vroegrijk notes that they often came up with their own ideas, including an interactive graph that shows how a course is structured. There was also a huge effort to catalogue class materials, select the right content, and in some cases make better versions of older materials. The team ultimately created the PRIME Catalogue website, with hundreds of high-quality mathematics course videos that can be easily filtered to find specific content. “When we show all of these materials to people, both inside and outside of TU Delft, they are amazed at what we have been able to do because it’s quite unique,” says Vroegrijk. “Those kinds of reactions are really nice.”

In the end, the team chose to publish their content with CC BY, the broadest, most open type of licence. But it takes more than that, says van Gelderen. “We have always tried to publish everything openly and maybe even more so now, but sometimes we forget that just sharing it is not enough. You also have to make it findable and easily accessible.”

Expert advice and support

It was the support of the people at the TU Delft Library that enabled the PRIME team to put their ideas into action. “Michiel de Jong knows a lot about education and publishing standards for open education so that was really helpful,” says van Gelderen. “They gave us a lot of attention, checking up on us and helped a lot with dissemination.” Vroegrijk agrees, saying, “The money helped, but it was not the most important part. The expertise, the following up, the sparring partner to talk about everything, that was really the most valuable thing.”

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Although there is still some work to be done, the PRIME team aims for a full rollout during the third academic quarter of this year. They will make Brightspace announcements on all PRIME course pages for students and are planning presentations for lecturers to spread the word. Van Gelderen notes that she has received quite a bit of interest from lecturers, so they want to continuing building on that momentum. They hope that making the materials easier to find will help students throughout their studies, and that colleagues will start using PRIME both at TU Delft and beyond.

Contributors:

Tom Vroegrijk, PRIME Programme manager, Electrical Engineering Mathematics & Computer Science faculty | Beryl van Gelderen, PRIME Coordinator, Electrical Engineering Mathematics & Computer Science faculty | Willem Schouten Straatman, Lecturer, Electrical Engineering Mathematics & Computer Science faculty | Christophe Smet, Lecturer, Electrical Engineering Mathematics & Computer Science faculty

From model to understanding

An open database for scientific visualisation

Project title: Open database for scientific visualisation

Being very passionate about scientific visualisation, the first thing that Martin Lesueur noticed when joining the TU Delft as an Assistant Professor in the Faculty of Civil Engineering and Geosciences was that the glass displays for showcasing research only contained physical items. “Concrete, pieces of rock, you name it,” he says. “But no scientific visualisations. Representing complex data in a visual and understandable form, these visualisations are essential in bringing abstract computational models to life – to showcase your results, to debug the model, to understand what is going on in there.”

Together with two colleagues and supported by funding from the Open Education Stimulation Fund, he set out to create an open resource for learning scientific visualisation. “It constitutes the first self-education resource available in this domain.”

Inspiration

Fruitful discussions with coordinators of the Stimulation Fund helped them shape their idea for an open resource. They then set out to integrate additional database functionality into the 4TU open research data repository, which is partially coordinated by TU Delft. “The idea is for students to be able to take inspiration from previous work,” Lesueur says. “Now, if they search for the keyword ***scientific visualisation**, they will see a gallery of thumbnail visualisations. We hired a student assistant to help out with creating thumbnail representations – a feature that was lacking in the 4TU repository – and to finetune the interface.”

“The examples are all generated with the best-known software in scientific visualisation, which is Paraview. As such, it will help the students build skills that are widely applicable during the rest of their education and career.”

The thumbnails allow students to quickly find the kind of visualisation they are looking for. They can then download the underlying data files and code and educate themselves on how the visualisation was created. “The examples are all generated with the best-known software in scientific visualisation, which is Paraview. As such, it will help the students build skills that are widely applicable during the rest of their education and career.”

Deeper insights

The database has already attracted, and impacted, a broad audience. “Full professors, PhD candidates that just started, master students doing projects in courses, even bachelor students,” Lesueur says. “We are targeting everyone, and we see that everyone is interested.” He also received much feedback from students that their scientific visualisation gives relevance to their project. “It is not only an awe-factor, but it also genuinely raises interest. You can move things around, better understand the data. And when they present their visualisations, their peers start asking different, deeper questions because it increases their understanding too. It’s not just numbers anymore.”

> “The goal is to have these students upload their own data and code as well, thereby continually expanding the database.”

The team organised a Paraview workshop – inviting people from various faculties – which is where most promotion of the database took place. The database has also been deployed in various courses where people work on projects that can benefit from visualisations. This includes the course on Advanced Computational Mechanics of Lesueur himself. “The goal is to have these students upload their own data and code as well, thereby continually expanding the database.”

Holograms

The team also used the funding for purchasing a holographic machine, which goes one step further than the database in that it makes visualisation even closer to a physical representation. It has become part of the Digital Construction Lab, which houses many other openly accessible physical resources such as robotic arms and a Virtual Reality room. “It has been a great success in showcasing scientific visualisations,” Lesueur says. “You can almost grab the visualisations and I see people in front of it bending and twisting to find interesting viewing angles.”

The team is really proud that the funding helped them to bring more life to scientific visualisation. And with computational modelling being taught in various forms in every faculty of TU Delft, it is difficult to underestimate the potential impact of their open database for scientific visualisation.

Contributors:

Martin Lesueur, Assistant Professor, Civil Engineering and Geosciences faculty | Oriol Colomés, Assistant Professor, Civil Engineering and Geosciences faculty | Frans van der Meer, Associate Professor, Civil Engineering and Geosciences faculty

Breaking the waves
the Coastal Dynamics Open Codebook

Project title: Coastal Dynamics Open Codebook

In the first 32 months after its publication in 2021, the ***Coastal Dynamics Open Textbook** (CDOT) was downloaded 15,500 times by users from at least 41 countries. At TU Delft, it supports the MSc course Coastal and Estuarine Systems at the Faculty of Civil Engineering and Geosciences. Despite its success, two challenges remained in maximizing the (re)usability of the textbook and embedding Open Educational Resources in teaching.

“We wanted to provide interaction functionality to the textbook, so that students can reinforce their skills and knowledge in an active learning-by-doing process,” says Judith Bosboom, senior lecturer and one of the two authors of the textbook. “We also wanted to keep our teaching materials up-to-date and establish a strong link between Open Research, Open Data and Open Education.”

Interactive content

Co-funded by the Open Education Stimulation Fund, a team of lecturers, assistant professors, and PhD candidates set out to develop the Coastal Dynamics Open Codebook. “The Coastal Codebook uses open-source software to provide interactive tutorials that help the students reflect on the textbook material,” says José Antolínez, Assistant Professor and co-developer of the open codebook. “It provides coding examples, example datasets, and knowledge sources the students can use for doing their own exercises. It then is their task to reach the objectives we set.”

“Coastal Codebook provides coding examples, example datasets, and knowledge sources the students can use for doing their own exercises. It then is their task to reach the objectives we set.”

The funding was used to hire additional development support staff; a student and a graduate from the Hydraulic Engineering MSc track that the Coastal Systems course is part of. They developed much of the content of the Coastal Codebook – together with the PhD candidates, who also contribute as teaching assistants to the Coastal Systems course. Students of the course have been essential too, by providing feedback on a preliminary release of the Codebook. “The new version is being released this year, sequentially, from January onwards,” Bosboom says. “In this way we can continue to use the experiences of the students of our Coastal Systems course, running in Q3, to improve the Codebook.”

Dynamic framework

The idea was for the Coastal Codebook to gradually evolve over time – staying up to date, rather than having it edited only every now and then. “The content can quickly be adjusted to absorb new research findings and data in a transparent way,” says PhD Candidate Floris Calkoen, who was responsible for the back-end development of the Codebook. “We therefore leverage tools from the Jupyter ecosystem, a new and emerging educational technology that is dynamic.”

The Coastal Codebook has also been built to function across all operating systems, maximising its functionality and reach. Bosboom: “It can eventually also be run on remote servers, solving any software challenges students may have on personal devices.”

For those interested in the underlying technology and its deployment, the Coastal Codebook is publicly available in a ***Github repository.** Calkoen: “The repository not only hosts the content but also includes workflows that automatically test notebooks before releasing them, bundled as Jupyterbook, on a ***static webpage.** We maintain our question and visualization framework through the ‘coastal dynamics’ Python package making it a robust and stable solution for the upcoming years.”

“It can eventually also be run on remote servers, solving any software challenges students may have on personal devices.”

Transforming education

The development of the Coastal Dynamics Open Codebook served as a pilot for the current transformation of the Hydraulic Engineering MSc track within the Faculty of Civil Engineering and Geosciences. “The Coastal Systems course with its Coastal Dynamics Open Textbook already was a quite complete and well-developed course,” Antolínez says. “Even so, there still was the ambition to further improve it. We thought this was a good basis for developing the Coastal Codebook.”

The pilot was well received by the department and a similar transformation initiative has been started for other courses, such as the Dredging for Sustainable Infrastructure course. “It will also feature an open codebook, created using our development platform,” Antolínez says. Bosboom: “We hope that, in time, the platform can serve as an example for dynamic educational course material well beyond the boundaries of TU Delft.”

Contributors:

Judith Bosboom, Senior lecturer, Civil Engineering and Geosciences faculty | José A. Á. Antolínez, Assistant Professor, Civil Engineering and Geosciences faculty | Floris Calkoen, PhD Candidate, Civil Engineering and Geosciences faculty | Stuart Pearson, Assistant Professor, Civil Engineering and Geosciences faculty | Chris Hoogervorst, Education Development Officer, Civil Engineering and Geosciences faculty | Mia Pupić Vurilj, PhD Candidate, Civil Engineering and Geosciences faculty | Jakob Christiaanse, PhD Candidate, Civil Engineering and Geosciences faculty | Mario van den Berg, PhD Candidate, Civil Engineering and Geosciences faculty | Kevin de Bruijn, MSc student, Civil Engineering and Geosciences faculty | Dani Guerra Medina, MSc student, Civil Engineering and Geosciences faculty

Sharing open education material more effectively with explainer videos

Project title: Cooking up Open Education Resources for the Resilience Engineering Community

Resilience engineering is a highly versatile, multidisciplinary approach for designing systems, solutions and technology that can help society face uncertainty – specifically regarding shocks or chronic stress. Think of minimizing disruptions in transportation systems because of accidents, keeping telecommunications operational despite cyberattacks and technical failures, or futureproofing cities against climate change.

“It being so versatile, means that there are many special angles in teaching resilience engineering comprehensively,” says Camilo Benitez, postdoc in the Technology, Policy and Management faculty and one of the project collaborators. “Educators therefore spent a lot of effort finding proper resources and adapting these to their educational needs.”

> “It being so versatile, means that there are many special angles in teaching resilience engineering comprehensively.”

Explainer videos

The 4TU Resilience Engineering community had already created a platform containing more than 200 open education resources for anyone to use. Think of figures, PowerPoint presentations, educational games. “The problem was that these weren’t always very intuitive to use,” Benitez says. “Our idea was to add short videos, of up to five people, to the resources in which the uploaders explain the essence of their material. How did they create it, what is the key message of their PowerPoint presentation? We even had the materials for a workshop uploaded, but it lacked an explanation as to how to use it.”

Funding by the Open Education Stimulation Fund allowed the team to hire an expert educator for a workshop they organised on best practices in creating open education video material. The funding also covered recording of the videos sometime later. “The TU Delft Media centre has been a great help,” Benitez says. “As was the student assistant we hired to take care of much of the logistics – pushing the project forward, aligning agendas. She also created many of the figures used in the explanatory videos.”

Community building

Originally aiming for ten videos, they eventually recorded fifteen. These cover open education materials shared by educators and researchers from four TU Delft faculties: Civil Engineering and Geosciences; Technology, Policy and Management; Architecture and the Built Environment; Industrial Design Engineering. “We also had a guest lecturer from the University of Twente record a video, meaning that our project went beyond the walls of TU Delft.”

Video recording was completed in January. After editing they can be found on the eduroam platform that already hosts the resilience engineering open education resources. Benitez: “We’ll promote the videos through the communication channels of the various TU Delft faculties, as well as those of the 4TU Centre for Resilience Engineering.”

> “The workshop and recording of the video has really taught me to draft effective narratives, to convey messages that are both assertive and understandable.”

Part of the promotion is to invite people to create their own videos and Open Education Resources (OER) materials, thus helping in keeping the resilience engineering engaged. “We specifically target PhD candidates who have recently started their research careers at universities. Eventually, if they want to stay in academia, they will need to build their teaching skills. We think this is a very valuable opportunity for them.”

Effective open education

Currently applied to resilience engineering, the approach to produce explainer videos for operationalising open education resources is, of course, transferrable to other domains. “In this regard, we contribute to new ways of recognising cross-sectional work when sharing educational knowledge.”

For Benitez himself the project will have lasting impact in both his teaching and in presenting his research. “The workshop and recording of the video have really taught me to draft effective narratives, to convey messages that are both assertive and understandable. I will take that along in my teaching.”

But what made him most proud was to look at his fellow educators when they were recording, to see them showcasing their expertise. “Producing open education materials is a very altruistic activity. It tends to suffer from low recognition while many people can benefit from it. It has been an important motivation for starting this project.”

Contributors:

Camilo Andres Benitez-Avila, Post-doc, Technology, Policy and Management faculty | Nazli Yonca Aydin, Assistant Professor, Technology, Policy and Management faculty | Carissa Champlin, Assistant Professor, Industrial Design Engineering faculty | Claudiu Forgaci, Assistant Professor, Architecture and the Built Environment | Juan Pablo Aguilar Lopez, Assistant Professor, Civil Engineering and Geosciences faculty | Maria Nogal-Macho, Assistant Professor, Civil Engineering and Geosciences faculty

Mastering computing skills for geomatics engineers

Project title: Improving computing literacy for geomatics engineers, one tool at a time

The geomatics master at TU Delft combines principles from geography, mathematics, and computer science to study and visualize spatial information. Think of 3D maps, remote sensing, surveying, and regional planning. Next to the required theories and concepts, the master involves a lot of computer skills for acquiring, analysing, interpreting, and managing geospatial data.

“Teaching has changed a lot in recent decades, it used to be more about knowledge and much less about processing data,” says Hugo Ledoux, Associate Professor at the Faculty of Architecture and the Built Environment. “The required tools and skills not being considered very ‘scientific’, they are often not taught in courses. We expect students to simply keep up. But the effort it takes for them to find the right tools, and master them, can be so overwhelming that it distracts them from what they should really be learning. I wanted to make this more manageable.”

The best tool for ‘X’

His solution was to develop a platform with a collection of interactive lessons on tools and workflows relevant to Geomatics engineers, covering all the major computing platforms. It’s an idea he had in his mind for some time, but it never gained traction. “Acquiring the funding from the Open Education Stimulation Fund gave my idea more credibility,” he says. “And it allowed me to hire two students who had attended all courses to help make an inventory of the tools and skills involved. That’s when things really started to take off.”

Tailored specifically to the geomatics master at TU Delft, the ***GeoGeeks website** contains tutorials on some very specific software and skills – the best tool to do ‘X’ as well as how-tos. But it also covers more general computer skills. These may be as mundane as how to use file systems or how to connect to a Linux server, or as complex as automating tasks through scripting, and version control and debugging techniques for software development. Having made the website available to anyone, students from other master’s programmes may also benefit from it.

Masterclass

Ledoux is especially proud that this academic year already, his efforts have led to the Geomatics master programme freeing up two full days in the second quarter for all the general computer skills on the website to be taught to the students. “It was rated very positively by the students, and most of the teaching staff also see the benefit,” Ledoux says. “This year, it was an experiment, but I think it will be integrated in the curriculum going forward. Without the grant, this would never have been possible.”

> “It was rated very positively by the students, and most of the teaching staff also see the benefit.”

Even though the two-day ‘masterclass’ felt a bit crammed with information, the students should now have a better understanding and know where to find more information if needed. “I think the combination of a masterclass and website will end up saving both the students and instructors a lot of time. The latter, as they will often be asked for help if a student gets stuck.” And when Ledoux gave a presentation at the TU Delft Open Science Day, the website idea was also favourably received by lecturers from other departments.

Another impact the project may have, is for the software tools used in the curriculum to become more harmonized. “Right now, each lecturer tends to use their own favourite tool for performing a certain task. But now that we have the complete overview, perhaps we can commit to limiting the number of tools for students to master. This is a human aspect that still needs some attention.”

Self-maintained

Although initially poised to have video tutorials at its core, the website ended up containing mostly text as videos are difficult to update whenever, for example, new software versions are released. In general, and now that funding has ended, the plan is for the website to be self-maintained and expanded by the master’s students. “I am not sure this will work, we have to see,” Ledoux says. “But we taught them how to do it, and support is on the website itself.”

Contributors:

Hugo Ledoux, Associate Professor, Architecture and the Built Environment faculty

A ‘what happened’ for engineers

The forensic training virtual escape room

Project title: Forensic Escape Room

Forensic engineering is about applying engineering expertise to determine causes of accidents and failures, to learn from them, and use this knowledge to prevent future incidents thereby enhancing safety. The very successful Delft Approach to forensic engineering is being taught to thousands of people each year in both online and offline courses. But there is only so much you can teach by using textbooks and videos, and examining case studies. A team of assistant professors from the faculties of Civil Engineering and Geosciences, Aerospace Engineering and Mechanical Engineering developed a virtual escape room.

“We wanted to add a hands-on, immersive experience to our forensic engineering course,” says Arjo Loeve. “What is it like to roam around an incident site, to search for clues, and especially for them to keep an open mind as to what they are seeing. Put simply: it isn’t always blood if you see splashes of a red substance on the wall.”

“The end result is amazing. The high quality of the graphics, the gameplay, it even includes grainy security footage of the bridge collapsing.”

Collapsed bridge

The team used the Open Education Stimulation Fund to hire a development company for creating a first-person 3D virtual escape room. A bridge collapsed, there’s a ship next to it with a broken chimney. What happened? Players can roam around the virtual incident site and collect information through observation, measurements, checking documents and conducting interviews. “Having a good, quick, and flexible developer team has been essential,” Loeve says. “The end result is amazing. The high quality of the graphics, the gameplay, it even includes grainy security footage of the bridge collapsing.”

Part of the funding by the Open Education Stimulation Fund was used to also hire a student assistant. “At each team meeting, we pitched all kinds of ideas. She made sure it became a coherent script. She also created tons of documents used in the virtual escape room, such as basic technical drawings of the ship that the player will need to peruse.”

A broad audience

Catering to various TU Delft faculties, as well as the MOOC – that is taken by lawyers, nurses, police, you name it – the biggest achievement has been to make the escape room interesting and challenging for a very broad audience. “During development, we had a test team providing continual feedback on difficulty and engagement as well as bugs and problems,” Loeve says. “It consisted of forensic engineering scientists, students, but also family members. All of them were super enthusiastic.”

> “The test team consisted of forensic engineering scientists, students, but also family members. All of them were super enthusiastic.”

The escape room takes a few hours to complete and includes some simple calculations. For their own students it will be a fun way of practicing what they have learned. But it is poised to play a role well outside their own educational network as, released on 9 February, it is available for anyone worldwide ***to play** and integrate into their teaching.

Going nuclear

Even in their own teaching, the impact of this open education project goes well beyond this one forensic escape room. Intending to gradually expand their Forensic Engineering MOOC, the team already has plans to create another virtual escape room, one with a nuclear component. And Loeve is also currently developing a MOOC on safety and CE certification of medical devices.

Perhaps the most important lesson for Loeve and the rest of the team has been that it is feasible, in both time and money, to improve education by implementing what seems to be a wild idea at first look. “If we want to add something special, such as a serious game, we can now better estimate its feasibility,” he says. “It helps to have a good developer and a capable student assistant. And it did cost me some spare time. But I hope our effort will inspire other educators to also go the extra mile for education.”

“I hope our effort will inspire other educators to also go the extra mile for education.”

Contributors:

Karel Terwel, Assistant Professor, Civil Engineering and Geosciences faculty | Michiel Schuurman, Assistant Professor, Aerospace Engineering faculty | Arjo Loeve, Assistant Professor, Mechanical, Maritime and Materials Engineering faculty

Open Education and The TU Delft Open Science Programme

From the start of the TU Delft Open Science Programme in 2020, it has always been unique among open science programmes in the Netherlands due to the prominent position of open education.

At the programme's onset, we established five projects reflecting all types of academic output created by our academic staff: open access, FAIR data, FAIR software, open scholarly publishing, and open education. Each project had its own goals and deliverables, including aspects of rewards and recognition, skills for open science, legal aspects, ethics, and research integrity. Along the way, we realised our open science programme needed two additional projects: open hardware and citizen science.

Advancing Open Education

The open education project began with the intention of helping teachers share their educational content online. However, we soon observed that open education encompasses much more than sharing open educational resources. It involves sharing teaching expertise broadly and changing how we organise information sources for students. Importantly, it leads to a change in how teachers and students interact with educational resources.

Starting in 2021, the Open Science Programme focused on demonstrating the value of creating, reusing, sharing, and publishing open educational resources within our bachelor's and master's programmes. This effort yielded several notable project results, including a publication service for open textbooks, the development of an open education training programme, and communities for teachers working with Open Educational Resources. Since 2022, TU Delft is the only university in the Netherlands with an institutional policy on publishing open educational resources, which helps to prioritise the subject within our faculties.

In 2023, the final year of the Open Science Programme, we recognised the need to expand the community of open education practitioners at TU Delft to make our programme results more relevant. This expansion involves broadening our views on how open education can improve our educational processes. Consequently, we launched the TU Delft Open Education Stimulation Fund to ask teachers about their identification with open education and support their development as practitioners. The response was overwhelming, with 25 applications received, 11 of which were funded through the programme, and another 13 projects starting this year. This illustrates the increasing importance of open education within our campus education.

“Open Education involves sharing teaching expertise broadly and changing how we organise information sources for students. Importantly, it leads to a change in how teachers and students interact with educational resources”.

The next phase

As a university, we must be prepared to facilitate this growth by developing support services, ICT infrastructure, policies, rewards and recognition systems, and teaching philosophies to make open education the standard. Essentially, we are undertaking a complete organisational transformation centred on teaching with open educational resources. This is why open education is an even bigger component of the next open science programme: TU Delft OS 2024-2028. This new programme will focus on reusing, creating, and publishing open educational resources with our teachers and students, developing open systems within our ICT infrastructure in collaboration with other university service centres, and introducing an open pedagogy to our bachelor’s and master’s programmes with input from all stakeholders in campus education.

None of this would have been possible without the pioneers of this year’s TU Delft Open Education Stimulation Fund.

I would like to **congratulate all our project leaders** for completing their projects and for their contribution to making open education the standard at TU Delft.

Dr.ir. Frank van der Hoeven
Programme manager
TU Delft Open Science Programme

Open education brings together educational innovations such as the increasing role of digital technologies in education, blended learning, and the increasing of students' autonomy in educational processes, and couples these with values of diversity and inclusion.

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