

# Fostering innovation in education

The Innovedum fund places 2 million Swiss francs annually at the disposal of the Rector to support initiatives that further develop education at ETH.

## Number of Innovedum projects submitted and approved (2004–2018)

### Teaching projects

Innovative projects that improve the quality of courses

### Focal point projects

Projects to promote specific topics (e.g. interactive teaching); supported since 2010

### Small projects

Projects with simple approval procedures and a budget of less than 30,000 Swiss francs; supported from 2007 to 2009

### Degree programme initiatives

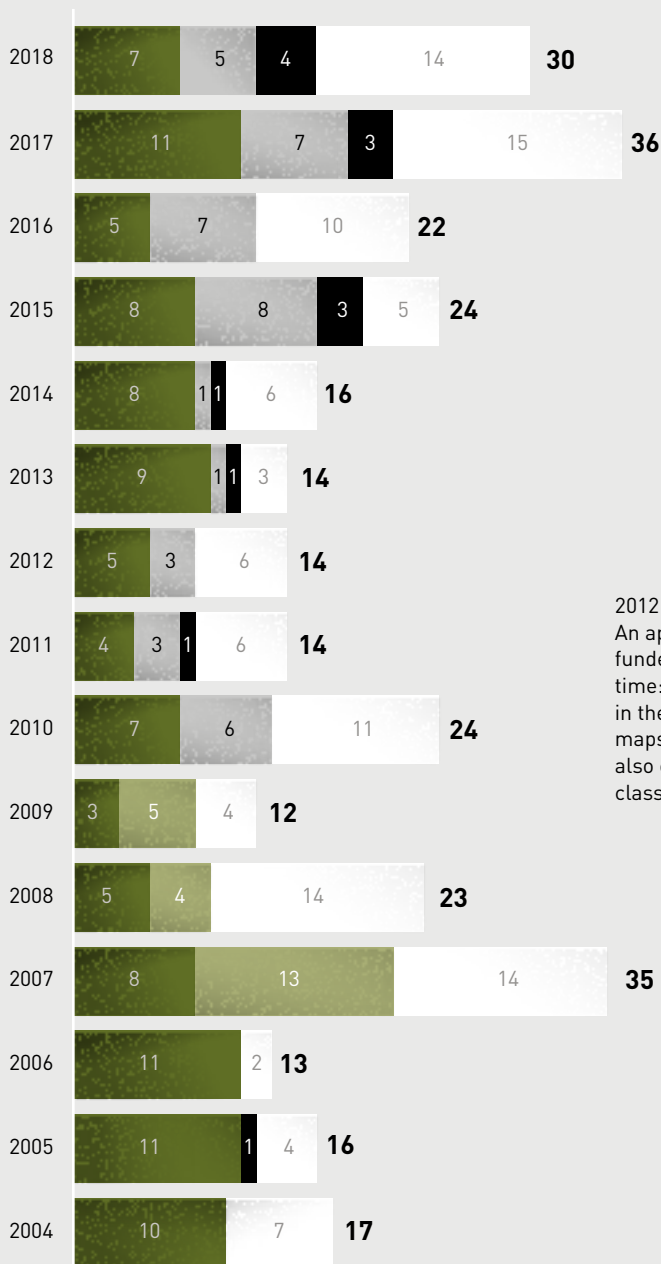
Initiatives to adapt the content of existing degree programmes or develop entirely new ones

### Unsuccessful proposals

Projects not supported by the fund

Total proposals submitted **310**

Total projects approved **189**



## Milestones in fostering innovation (selection)

### 2017 Degree programme initiative

The aim of this initiative is to incorporate cross-disciplinary skills (communication skills, critical thinking) into the curriculum of the Bachelor's programme in geospatial engineering, and to integrate them with existing core skills (modelling, programming).



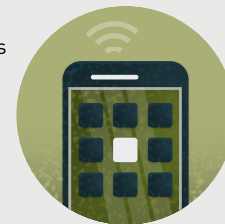
### 2015 Optimising courses in real time

The online tool PELE – the personal electronic learning environment – gives lecturers the unprecedented ability to systematically optimise their courses in real time with the help of electronic data. Every week, the lecturer tracks how much time the students spend on tasks, noting where they progress quickly and where they have problems.



### 2012 App for students

An app for the teaching domain was funded and developed for the first time: EduApp helps ETH students in their everyday lives (study plans, maps, student workplaces) and also enables feedback in the classroom (clicker questions).



### 2007 Electronic exams

With the help of the Innovedum fund, a program was developed to help staff design exams flexibly, and give and grade them electronically. The project also contained a database of exam questions.



### 2002 Flipped classroom

The Filep fund, active until 2004, supported a flipped-classroom project on programming. As the name suggests, the traditional set-up is reversed: usually students learn in the lecture hall and do exercises at home. In a flipped classroom, they learn at home and come to the university to do the exercises.



# Teaching

At ETH Zurich, knowledge transfer starts in schools. A range of teaching projects are used to familiarise pupils with the scientific approach to work and study. Above all, they should be motivated to develop their own creative ideas.

In the degree programmes, ETH Zurich continually adapts the learning environment to the current needs of students and lecturers, and to the future requirements of business and society. Teaching innovations are characterised by interaction, practical orientation and new technologies. ETH is creating more room for open and flexible learning spaces. These, along with aids such as online lesson evaluations or mixed reality techniques, are designed to help further improve teaching. ETH Zurich is also able to respond to the continuing strong growth in student numbers by holding e-tutorials and online exams. In 2018, more than 21,000 students enrolled across all study levels – an increase of almost 4 percent over the previous year.

ETH Zurich founded the School for Continuing Education to bring together its continuing education programmes and develop new courses. The university is also working with industry to develop customised continuing education programmes.

## INNOVATION IN TEACHING

## A more open curriculum

**Teaching at ETH Zurich is becoming more project-based and interactive, preparing students for the professional demands of the future and their role in society.**

Today's world is characterised by rapid information growth and technological change. "In our work of communicating knowledge, skills and values, it is increasingly a question of combining a solid education in science and technology with application-oriented and practical aspects – and placing it all in a broader context," says Andreas Vaterlaus, Vice-Rector for Curriculum Development and Professor for Physics and Education.

The trend towards project-based and applied teaching using interactive methods is also reflected in changes to ETH Zurich's buildings. Of course there are still auditoriums, especially for the big lectures at the beginning of a degree course, but there are also more and more open and flexible learning spaces: rooms with different zones, with places where people can meet and discuss, and quiet areas where students can concentrate and get on with their independent work.

**The aim is to combine a solid education in science and technology with application-oriented and practical aspects.**

The point about these innovative teaching approaches is that, on the one hand, they employ new kinds of teaching aids, making the most of modern study methods, while on the other hand they improve communication between lecturers and students. For example, an online tool allows students to evaluate a lecture while it is still in progress, rather than at the end when it is too late for the students to benefit from the lecturer's changes.

The EduApp, one of the most successful projects from Innovedum (Innovedum

projects are initiatives supported by the university aimed at further developing teaching at ETH), also enriches teaching by promoting interaction between lecturers and students. The EduApp contains a clicker function, for example. Lecturers can ask their audience questions during the lecture, like a quiz. In 2018, students on 216 different courses gave 274,693 answers to questions that not only made them think, but also helped to identify and clear up possible misunderstandings. The EduApp also offers a course forum for each lecture. It works like a group chat, where students can ask questions about the lecture and discuss them with the lecturers or their peers. In future, the application may even be able to coach students through the course or help them plan their studies.

Technological innovations aside, teaching is also constantly being rethought and redeveloped. Traditional lectures are increasingly giving way to other methods. In



In the flipped classroom, students discuss what they have learned at home.

the flipped classroom, for example, students learn at home with self-study materials, then discuss what they have learned in class, for example by solving in-depth exercises in groups.

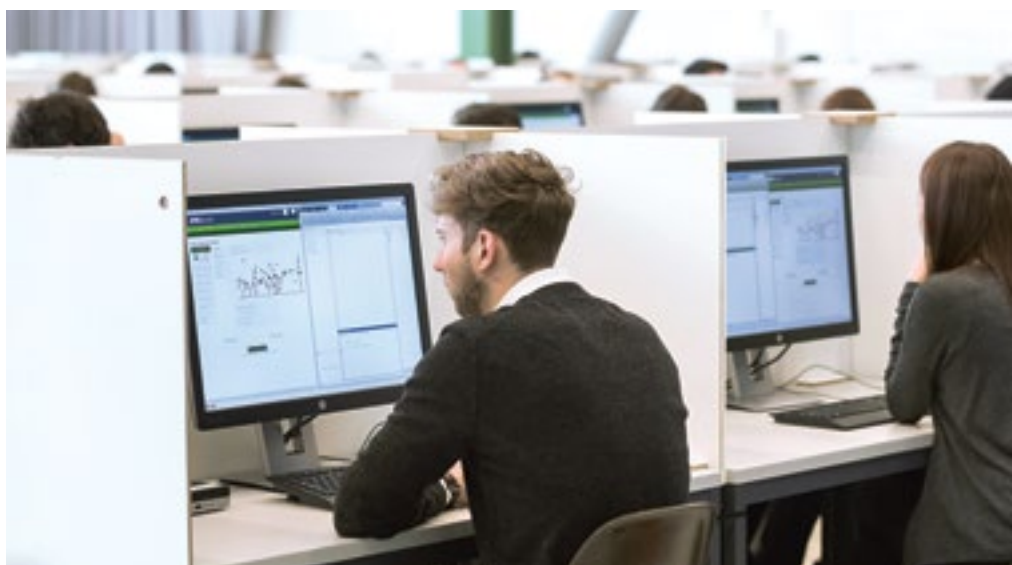
ETH studies today are less about acquiring encyclopaedic knowledge and more about having time to practise, to acquire knowledge for oneself and assess specific cases. Students should not only apply methods to complex problems and think critically about theories; they should also synthesise knowledge from different subjects and learn to work together across disciplines.

ETH Zurich continuously adapts the learning environment to the current needs of students and lecturers, in order to ensure that students receive a top-level education. With all the changes taking place, the only constant is the goal: to enable ETH graduates, as independent thinkers, to shape the future. ■

[www.ethz.ch/innovative-teaching](http://www.ethz.ch/innovative-teaching)  
[www.ethz.ch/education](http://www.ethz.ch/education)



**ETH Zurich increasingly uses self-study materials and in-depth exercises rather than traditional lectures.**



**The ONA building's multifunctional hall in Oerlikon during an online exam.**

#### ONA E7 UP AND RUNNING

### A new room for online exams

In Zurich-Oerlikon, a new room for online examinations has been in use since January 2018. It is the largest so far, with 240 seats. During the semester, the Department of Architecture uses this multifunctional hall for students' practical work. At the end of each semester, room ONA E7 is converted for the next exam session. The space can be partitioned into multiple sectors, which means that students from different courses can sit exams at the same time. Additional network cabling had to be installed and various hardware combinations intensively tested before the room could be used.

Students acting as pilot users took part in ergonomic trials. Those working in room ONA E7 now have plenty of space for writing materials, exam aids – and of course snacks for calming the nerves. In view of the positive experience gained in ONA E7, the new hardware will soon replace that currently used in other exam rooms. ■

<https://blogs.ethz.ch/id/2018/06/26/online-pruefungen-an-der-eth-ona/>  
 (available in German only)  
[www.ethz.ch/online-examinations](http://www.ethz.ch/online-examinations)

#### KITE AWARD

### Honouring educators

For the second time, ETH Zurich's Lecturers' Conference presented the KITE Award, which recognises pioneering teaching concepts. Worth 10,000 Swiss francs, the prize went to Luke Fässler, Markus Dahinden and David Sichau in 2018. Their e-tutorials teach the basics of IT to more than 800 first-semester students from five departments.

Some 90 percent of prospective natural science students have little prior knowledge of this subject. Instead of making students cram the basics of IT through an introductory lecture, the three lecturers

take a hands-on approach: students work in a practical setting or a virtual programming laboratory from day one, solving problems with real data from the subjects they are studying. For example, students have to contain an infectious disease or calculate an ocean current. The learning process is more fun that way, while simultaneously giving students serious grounding in IT. The e-tutorial, which is tailored to their knowledge, not only allows students to test their knowledge for themselves, it also helps them think independently and criti-

cally and work together efficiently in interdisciplinary teams. The personalised support system of the e-tutorials also allows one-to-one project presentations with a learning coach, individual feedback and mutual assessment, even with large courses. ■

[www.ethz.ch/kite-award-en](http://www.ethz.ch/kite-award-en)



## GOLDEN OWL AWARDS

## Awards for outstanding lecturers

Semester feedback, course assessments, student surveys: ETH is keen to hear what students think about the teaching they receive. And feedback from students themselves is often the best way to keep standards high. For some years now, ETH Zurich's student association VSETH has presented the Golden Owl award to recognise exceptional teaching. One lecturer per department receives this honour. The 2018 winners are:

- Professor Alexander Lehnerer (D-ARCH)
- Professor Walter Kaufmann (D-BAUG)
- Professor Markus Aebi (D-BIOL)
- Professor Randall Platt (D-BSSE)
- Dr Rolf Heusser (D-CHAB)
- Dr Marcel Frehner (D-ERDW)
- Paula de Avila Widauer (D-GESS)
- Professor Christopher Robert Pryce (D-HEST)
- Professor Juraj Hromkovic (D-INFK)
- Professor Christian Franck (D-ITET)
- Professor Volker Hoffmann (D-MTEC)
- Professor David J. Norris (D-MAVT)
- Professor Pietro Gambardella (D-MATL)
- Professor Manfred Einsiedler (D-MATH)
- Professor Jonathan Home (D-PHYS)
- Professor Kristopher McNeill (D-USYS)

All previous winners of the Golden Owl award are automatically nominated for the Credit Suisse Award for Best Teaching, which is presented by the Credit Suisse Foundation and VSETH. This award can only be won once during the course of a teaching career. Professor Markus Reiher from the Department of Chemistry and Applied Biosciences received the award in 2018. ■

[www.ethz.ch/owl](http://www.ethz.ch/owl)



Mixed reality brings new insights: technologies such as the HoloLens – used here in the field – have potential as training aids.

## MIXED REALITY

## Holograms in education

**ETH uses the latest technologies in its teaching activities to enable students to see the surface of proteins, for example, or to access information about the diversity of lichens on trees.**

Mixed reality is the name given to applications in which computer-generated images overlap with views of the real world. Placing virtual elements in a real environment often makes them easier to appreciate and understand. To explore the potential of this technology in a learning context, and thanks to a donation from ETH alumnus Adrian Weiss, the Educational Development and Technology administrative department (LET) purchased 12 HoloLens glasses and launched the Learning in Mixed Realities project in 2018.

LET invites lecturers to submit proposals for the use of these glasses in teaching. The first winning idea came from the Institute of Pharmaceutical Sciences. The glasses will be used in a two-week practical as part of the Computer-Assisted Drug Design course. Master's students can use the HoloLens to view three-dimensional images, or holograms, of pharmaceutically relevant protein structures. The camera built into the glasses allows students, with just a few manual steps, to "walk around" or dive into the structures. Students not only develop an accurate idea of the spa-

tial distribution of a protein, they also learn how to select from a catalogue of millions of different molecules those that fit precisely into the indentations on the surface and can therefore be considered as potential new active substances.

Meanwhile, ETH lecturers have been carrying out other projects on the use of mixed reality in teaching. For example, environmental sciences students on a biodiversity field trip used a HoloLens app for the first time to map lichen colonies on tree bark. The app recognises trees by their bark texture and helps students by allowing them to tag colonies of the same species or retrieve detailed information about individual lichen varieties, such as sketches of typical patterns. ■

[www.ethz.ch/hololens-news](http://www.ethz.ch/hololens-news)  
[www.ethz.ch/mixed-realities-learning](http://www.ethz.ch/mixed-realities-learning)

## A new home for continuing education

**Lifelong learning is becoming increasingly important. ETH Zurich is responding to this trend by founding a School for Continuing Education. It brings together various continuing education programmes and supports the development of new learning opportunities.**

One of the effects of the rapid growth of information is that continuing education becomes a lifelong task, with more and more working people moving flexibly back and forth between training and applying what they have learned. This is the context in which ETH Zurich launched the School for Continuing Education in 2018. Under the auspices of the new school, ETH's range of continuing education options – 17 MAS (Master of Advanced Studies), 8 DAS (Diploma of Advanced Studies) and 20 CAS (Certificate of Advanced Studies) courses, as well as further education courses and online programmes – are grouped into four categories: Environment, Infrastructure & Architecture; Technology, Management & Innovation; Public Policy & Governance; and Health, Life & Natural Science.

“By bringing courses together in this way we want to encourage dialogue between thematically related continuing education programmes,” says Paolo Ermanni, Professor at the Institute of Design, Materials and Fabrication and, since 2015, Vice Rector for Continuing Education. “Our aim is clear: we want to provide an attractive, high-quality offering. In order to do so, we’re creating new structures and improving collaboration within ETH.”

The new school and the targeted expansion of the course – around 20 new



Continuing education is a key pillar of knowledge transfer at ETH Zurich.

continuing education programmes are in preparation – are intended to improve the visibility of ETH's continuing education opportunities. One of ETH Zurich's core tasks is to educate and train specialists in scientific and technical fields. But in addition, the university sees its continuing education programme as a “means of cultivating relationships with industry and society,” as Ermanni describes the transfer of knowledge from academia to practice.

ETH hopes that the new School for Continuing Education will enable it to react more flexibly to the needs of the labour market. Since autumn 2018, the university offers two new continuing education programmes in the field of cybersecurity. The DAS Cyber Security is aimed at professionals who already have IT training. Course participants learn the basics of information security and discuss current results and insights offered by research. The CAS Cyber Security targets a broader audience, which explicitly includes non-IT specialists. The course is aimed at people who

deal with questions of information security in their day-to-day work and want to acquire a well-grounded basic knowledge of the relevant issues.

Close connections with industry are a key part of the School for Continuing Education. For example, a customised continuing education programme has been created in dialogue with industry at the Competence Center for Materials and Processes. It is tailored to the experience and interests of one or more course participants. During their ETH Sabbatical, industry professionals can work on a scientific question in a research laboratory. They have access to a professor from ETH Zurich who acts as their mentor.

Seventy groups are currently taking part in this continuing education programme. The customised programme is an excellent example of how the School for Continuing Education combines the latest knowledge with critical thinking and practical problem-solving skills. The teaching and learning formats applied in continuing education courses not only promote the exchange of knowledge and experience, they also facilitate networking. In the future, Ermanni hopes that the School of Continuing Education will continue to “implement exciting new programmes that build on the expertise of ETH Zurich and are relevant to industry and society.” The more people ETH is able to attract to its continuing education programmes, the more the social benefits of the knowledge gained at ETH will grow. ■

[www.ethz.ch/continuing-education-press-release](http://www.ethz.ch/continuing-education-press-release)  
[www.ethz.ch/continuing-education](http://www.ethz.ch/continuing-education)



Challenge the best – ETH Zurich's campaign for continuing education.

## Students and degree awards

Students	Total		Bachelor's		Master's		Doctoral		MAS/MBA students		Visiting/ exchange students	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
<b>Headcount</b>	<b>20,607</b>	<b>21,397</b>	<b>9,262</b>	<b>9,517</b>	<b>6,158</b>	<b>6,590</b>	<b>4,092</b>	<b>4,175</b>	<b>646</b>	<b>635</b>	<b>449</b>	<b>480</b>
Percentage women	31.8%	32.3%	31.2%	32.7%	31.6%	31.0%	31.7%	32.1%	41.0%	43.1%	36.1%	30.8%
Percentage international students	38.7%	39.4%	19.9%	20.4%	40.7%	41.6%	71.4%	72.9%	41.8%	40.6%	94.7%	93.5%
<b>Total registrations</b>	<b>21,102</b>	<b>21,886</b>	<b>9,671</b>	<b>9,922</b>	<b>6,166</b>	<b>6,608</b>	<b>4,092</b>	<b>4,175</b>	<b>724</b>	<b>701</b>	<b>449</b>	<b>480</b>
Architecture and Civil Engineering	3,587	3,574	1,674	1,723	1,258	1,209	437	422	127	125	91	95
Engineering Sciences	7,430	7,825	3,547	3,650	2,280	2,546	1,405	1,443	18	22	180	164
Natural Sciences and Mathematics	5,307	5,469	2,511	2,480	1,346	1,505	1,144	1,165	209	197	97	122
System-oriented Natural Sciences	3,828	4,085	1,889	2,026	939	1,008	836	865	115	118	49	68
Management and Social Sciences	950	933	50	43	343	340	270	280	255	239	32	31
<b>New students</b>	<b>7,446</b>	<b>7,688</b>	<b>2,918</b>	<b>2,937</b>	<b>2,544</b>	<b>2,739</b>	<b>993</b>	<b>991</b>	<b>292</b>	<b>261</b>	<b>699</b>	<b>760</b>
Architecture and Civil Engineering	1,241	1,145	424	463	502	381	110	97	90	61	115	143
Engineering Sciences	2,627	2,785	1,046	1,071	935	1,089	343	331	8	10	295	284
Natural Sciences and Mathematics	1,901	1,994	842	766	595	721	258	273	48	52	158	182
System-oriented Natural Sciences	1,317	1,444	593	626	389	452	207	220	40	37	88	109
Management and Social Sciences	360	320	13	11	123	96	75	70	106	101	43	42
<b>Country of education</b>												
Switzerland	13,921	14,278	8,373	8,544	3,838	4,059	1,220	1,178	461	458	29	39
EU	4,847	5,082	1,099	1,167	1,428	1,528	1,901	1,969	157	144	262	274
Rest of Europe	516	572	114	126	179	215	179	189	20	15	24	27
Asia	1,207	1,330	56	56	504	577	508	557	52	48	87	92
America	479	487	23	23	170	177	228	225	25	25	33	37
Africa	83	98	4	5	28	36	43	49	5	6	3	2
Australia and New Zealand	49	39	2	1	19	16	13	8	4	5	11	9

Degrees and diplomas	Total		Bachelor's		Master's		Doctoral		MAS		Teaching diploma/ MAS SHE		Teaching certificate	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
<b>Degrees</b>	<b>4,777</b>	<b>4,957</b>	<b>1,606</b>	<b>1,678</b>	<b>2,072</b>	<b>2,196</b>	<b>827</b>	<b>802</b>	<b>182</b>	<b>184</b>	<b>62</b>	<b>48</b>	<b>28</b>	<b>49</b>
Architecture and Civil Engineering	918	844	373	281	381	410	79	94	85	59	0	0	0	0
Engineering Sciences	1,545	1,655	537	607	733	786	265	250	0	0	4	2	6	10
Natural Sciences and Mathematics	1,183	1,264	365	425	506	559	268	238	4	14	40	25	0	3
System-oriented Natural Sciences	896	942	318	349	355	359	170	172	13	5	18	21	22	36
Management and Social Sciences	235	252	13	16	97	82	45	48	80	106	0	0	0	0

ETH AS A TALENT FACTORY

## Expertise for the Swiss labour market

A total of 86 percent of Bachelor's students enrolled at ETH Zurich have been through the Swiss education system. Their initial year of study at ETH is quite demanding and culminates in first-year examinations. Around 35 percent of students leave the university without finishing their undergraduate degree, with almost half of those abandoning their studies before the first-year examinations. Fortunately, 90 percent of all students who pass their first-year exam go on to successfully complete their Bachelor's degrees.

Most ETH students who finish their Bachelor's degrees then carry on to a Master's course at the university, with 95 percent following this progression. They account for around two thirds of all Master's students. A quarter of students come from international universities, with more than 4,000 students from abroad applying for an ETH Master's course this year.

The average period of study for completing both a Bachelor's and Master's degree is 11 semesters, while the Master's programme generally takes four semesters for students without a Bachelor's degree from ETH. Students on Master's programmes have a success rate of 94 percent.

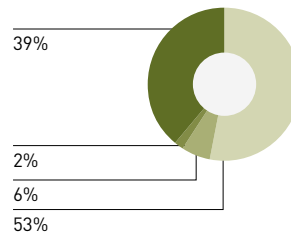
Most of the students graduating from the university bring their knowledge and skills into the Swiss employment market. A fifth of Master's graduates take their education a stage further by pursuing their doctorate at ETH Zurich.

Graduates from ETH Master's programmes make up around 40 percent of all doctoral students. The other 60 percent or so come mainly from foreign universities. Three quarters of doctoral students are employed as scientific staff at ETH.

Almost 90 percent of ETH doctoral students successfully complete their doctorates at ETH after an average of four and a half years. Although more than half of them come from abroad, 74 percent go on to work in Switzerland after completing their doctorates.

### Doctoral students

- ETH Zurich
- EPFL
- Other Swiss universities
- International universities

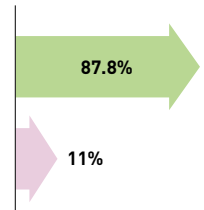


### Transition to doctorate at ETH Zurich



### Doctorate

Place of work after one year  
74% in Switzerland  
26% abroad

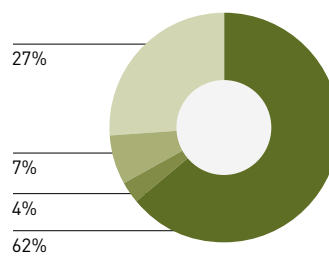


### Withdrawal without doctorate

1.2% remaining

### Master's students

- ETH Zurich
- EPFL
- Other Swiss universities
- International universities

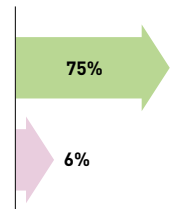


### Master's study at ETH Zurich



### Master's degree

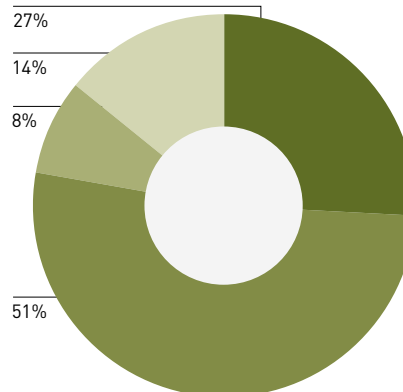
Place of work after one year  
91% in Switzerland  
9% abroad



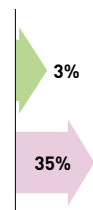
### Withdrawal without Master's degree

### Bachelor's students

- Canton of Zurich
- Rest of German-speaking Switzerland
- French- and Italian-speaking Switzerland
- Students educated abroad



### Master's study at another university, job or interruption



### Withdrawal without Bachelor's degree

Student data based on the average for the period 2013–2018; study success: matriculation cohorts 2007–2012 (Bachelor's, doctorate) or 2008–2013 (Master's); study duration: graduating cohorts 2013–2017; graduates' place of work one year after completing their studies: average of graduates of the years 2012, 2014 and 2016 from the FSO graduate survey



## GROWTH OF STUDENT NUMBERS

## The number of ETH students is growing and so is the percentage of women

With 21,397 new students, ETH Zurich is seeing further strong growth in student numbers across all levels (Bachelor's and Master's, doctoral, continuing education, visiting and exchange students). This represents a 3.8 percent increase on the previous year.

While the number of new students enrolling in Bachelor's programmes changed only slightly compared with the previous year (+0.7 percent), the number of new students enrolling in Master's programmes increased by 7.7 percent compared with 2017. It is noticeable that the number of women entering the Bachelor's programme increased by 7 percent, while the number of men decreased by 2.5 percent. As a result, the percentage of female students enrolling in undergraduate degree programmes rose to over 35 percent.

For those students enrolling in Master's programmes, the picture was reversed, with

the number of men increasing by 12.6 percent and women declining by 2.5 percent. There was a notable increase in the number of students from outside ETH enrolling in Master's courses (up by 14.5 percent, a similar rise to 2016).

The percentage of students with foreign entry qualifications is increasing among new students: this is true of Bachelor's and Master's students (up by 1 and 2 percentage points respectively) as well as doctoral students (up by 3 percentage points).

The total number of students who enrolled in undergraduate courses was 0.7% up on the previous year. With 434 new students, Mechanical Engineering remains the most popular undergraduate course, although the upward trend of recent years has slowed, with a fall of 9 percent compared with the previous year. The number of undergraduates studying Computer Science continued to grow strongly, up by 15 percent

on the previous year, making the Computer Science Bachelor's programme the second most popular course, with 374 new entrants. Architecture (with 262 new entrants) and Health Sciences (219) also recorded an increase, while Physics with 216 new entrants is attracting fewer students (down by 11 percent).

Most ETH Bachelor's graduates (95 percent) continue their studies on one of the ETH Master's programmes.

The student-faculty ratio has deteriorated slightly over the years, due to rising student numbers. In 2018, one professor on average supervised 43.5 students from all categories (2000: 32; 2008: 39). ■

[www.ethz.ch/academic-services](http://www.ethz.ch/academic-services)

## MAS ARCHITECTURE AND DIGITAL FABRICATION

## Wooden pergola made by robots provides a shady spot

The large roof terrace of the Istituto Svizzero in Rome was almost unusable, being exposed to scorching sun. But now it has a shady wooden pergola. It was created by students taking the MAS course in Architecture and Digital Fabrication. The study project gave them an overview and understanding of electronic planning and construction processes.

The structure requires no glue, nails or screws. Wood-to-wood joints were common in the Middle Ages, but were superseded by industrial construction methods. Now, thanks to robotic manufacturing, they are back in the limelight. The students designed a system of 700 wooden elements on screen and then produced it within three weeks in the Robotic Fabrication Laboratory at

ETH Zurich. In Rome, the students assembled the elements by hammering in 2,700 wooden dowels that had previously been shrunk in an oven. Once the dowels were in the digitally positioned holes, they merely had to be moistened and allowed to swell, turning the terrace into a pleasant spot. ■

[www.ethz.ch/wooden-pergola](http://www.ethz.ch/wooden-pergola)

The pergola's structure requires no glue, nails or screws.



## ETH IN DIALOGUE

## School partnerships

**Through a variety of projects, ETH Zurich is helping schools find more scope to develop their own ideas, besides teaching facts and methods.**

Juraj Hromkovic, Professor of Information Technology and Education, begins his entry in ETH Zurich's Zukunftsblog with a story: Martha had never stood out as a pupil until Year 6, when she took part in the Programming in School project. Martha set to work enthusiastically and not only completed the tasks in no time, she also helped the other pupils to solve the problems, because she could explain the programming tasks even better than the teacher. In the subsequent programming competition she not only solved all the tasks correctly, but also completed three tricky additional ones. No child had ever managed that before, and that was how Martha's exceptional talent was recognised.

Professor Hromkovic is the head of teacher training for the computer science teaching diploma at ETH. In 2005, he founded a training and advice centre for computer science teaching, where projects such as



During the field trip, the pupils observed insects visiting flowers.



The pupils compared plant diversity in heavily and lightly used farmland.

Programming in Schools are developed. To date, some 12,000 children in more than 200 schools throughout Switzerland have taken part. Professor Hromkovic says that his team came across "enthusiastic children, driven by a sense of achievement as they develop their own functional products by themselves."

The aim of the Lernfeld project, which is based at the Institute of Agricultural Sciences, is to introduce pupils between Year 5 and their final year at secondary school to scientific working methods and approaches. The youngsters explore the role of agriculture in relation to biodiversity and climate change, guided by graduate students who gain teaching experience in the process. As with real research, the pupils have to formulate a hypothesis which

they then test through meticulous observations. Back in the classroom afterwards, they evaluate the data that they collected in the field. Finally, they present their findings to experts and fellow pupils and put their conclusions forward for discussion. ■

[www.ethz.ch/blog-computer-science-education](http://www.ethz.ch/blog-computer-science-education)  
[www.ethz.ch/lernfeld-campaign](http://www.ethz.ch/lernfeld-campaign)

## DUCKIETOWN TEACHING PROJECT

## Automated driving with rubber ducks

In the Duckietown teaching project, students from ETH Zurich, along with others from Montreal and Chicago, operate a fleet of small, self-driving vehicles. Each of the "Duckiebots" has a trademark rubber duck on board. The vehicles navigate streets marked out with adhesive tape. What looks like child's play is based on highly complex systems in which hardware components, sensors and motors have to work in harmony. The participants work in teams com-

posed of students from three universities and spend a semester working on a particular aspect of these interactions. The greatest challenges are often not theoretical, but practical, such as low-angle sunlight which tends to put the robots off course. In the Duckietown project, students learn to deal with the fact that there are no perfect systems in robotics. The solutions that the students work out are made freely available, and the code that controls the

Duckiebots is open source, thus enabling enthusiasts all over the world to benefit from this pioneering work. There are also key benefits for the students. By demonstrating that they can coordinate their project and deliver it under time pressure, they meet their learning objectives and at the same time acquire a skill that is in great demand in industry. ■

[www.ethz.ch/duckietown-news](http://www.ethz.ch/duckietown-news)