Diversity and Inclusion in Teaching and Learning

Editors

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Foreword

Prof. Dr. Sarah Springman
Rector ETH Zurich, 2015 – 2022

Diversity and Inclusion in the Teaching and Learning Environment

Diversity and openness have been strengths of ETH Zurich since its foundation and contribute to ETH being one of the most renowned universities worldwide. As an expression of the cultural and linguistic diversity, these first lines are written in three Swiss national languages as well as in English.

> Diversität und Offenheit sind seit ihrer Gründung Stärken der ETH Zürich und tragen dazu bei, dass die ETH eine der renommiertesten Hochschulen weltweit ist. Als Zeichen dafür, dass die kulturelle und sprachliche Vielfalt ein wesentliches Merkmal von Diversität und Offenheit ist, sind diese Zeilen in drei Schweizer Landessprachen und auf Englisch geschrieben.

La diversité et l'ouverture d'esprit sont des points forts de l'EPF Zurich depuis sa fondation et contribuent à faire de l'EPF Zurich l'une des hautes écoles les plus renommées au monde. Comme expression de la diversité culturelle et linguistique, ces lignes sont écrites dans trois langues nationales suisses ainsi qu'en anglais.

> La diversità e l'apertura mentale sono i punti di forza del Politecnico di Zurigo fin dalla sua fondazione e contribuiscono a fare del Politecnico di Zurigo una delle università più rinomate al mondo. Come espressione della diversità culturale e linguistica, queste righe sono scritte in tre lingue nazionali svizzere oltre che in inglese.

The teaching and learning environment at ETH should ensure that students are able to achieve their full potential, whatever their background, gender or social class. Developing unused potential is a central aim for ETH. One of the key aspects is to promote diversity in the teaching and learning environment.

This issue of the ETH Learning and Teaching Journal gathers articles on some projects, and initiatives, which exist in the ETH Community whose aims are to increase diversity in the learning environment. Some initiatives support bachelors' students in their first year, others encourage reflection of how we could do better to integrate and encourage students from all backgrounds, while still others describe changes made in the curriculum to raise awareness of gender issues and increase inclusivity in particular disciplines. There are also articles from student and staff associations showing how involved the whole ETH community has become in promoting diversity. In addition, ETH's "Barrier-Free Initiative", begun in 2021, is presented here with the many aspects of making the university more accessible to students with different learning needs.

Creativity and innovation in a university is enhanced substantially by including and enabling students from every sector of society. ETH members are already involved in numerous projects to ensure our students reach their potential. Working together in the next years we can expand the impact of our collective work to increase diversity in the learning and teaching environment.

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Editorial

Globalisation and internationalisation have made the world more complex, and every society is more pluralistic nowadays, with a consequent impact on universities. ETH aims to be open to students, teachers, and researchers from all over the world. Therefore, our university culture deals with a challenging situation where not only student numbers are increasing, but this growing student body is more heterogeneous than ever before – in terms of gender, national origin, cultural background, individual learning strategies and learning goals. Teaching, and the curricula of study programmes, have to react and adapt to these changes. As a result, diversity and inclusion in teaching and learning has become an international topic for higher education. Concepts for diverse learning environments such as Inclusive Pedagogy[1] and Universal Design for Learning[2] have gradually spread to universities.

The European University Association (EUA) has published a report on "Diversity, equity and inclusion in European higher education institutions". The report is the result of an extensive survey of 159 higher education institutions, including ETH Zurich. The survey shows that awareness of diversity and inclusion still needs to be raised. In their conclusion, the authors state: "Part of this awareness raising would be to continue to move the discourse on diversity from a challenge to be solved to a precondition for quality and excellence. A number of prominent universities have already explicitly taken this position, as they realise that through ensuring equitable treatment, they improve their learning environment as well as their research." (Claeys-Kulik et al. 2019, p. 44)[3]

This issue of the ETH Learning and Teaching Journal focusses on Diversity and Inclusion in Teaching and Learning. The articles published here present a snapshot of some of the projects and initiatives on this topic, which have been implemented at ETH in the last few years. There are contributions from six university departments and three associations of the ETH community. The journal also includes an interview with the head of the new ETH Diversity Office (formerly: equal!), a presentation on the project "Barrier-Free at ETH", and a report on the project "Diversity-sensitive degree programme development - personalisation of learning", which is a collaboration between the University of Teacher Education Lucerne and ETH Zurich within the swissuniversities P7 funding programme "Diversity, Inclusion and Equity" (2021-2024).

Zurich, January 2022

Anna Garry, Elke Tomforde & Benno Volk
Issue editors

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[2] CAST (2018). Universal Design for Learning Guidelines, version 2.2: http://udlguidelines.cast.org

[3] Claeys-Kulik, A.-L., Jørgensen, T. E. & Stöber; H. (2019). Diversity, Equity and Inclusion in European Higher Education Institutions. Results from the INVITED project. European University Association (EUA). Online: https://eua.eu/resources/publications/890:diversity,-equity-and-inclusion-in-european-higher-education-institutions-results-from-the-invited-project.html

Improving the learning environment in the Department of Physics: a peer mentoring program for first-year female physicists alongside changes in the lecture program

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Abstract

In 2018, a D-PHYS evaluation of the Basisjahr (first Bachelor year) pass rates showed an imbalance of the pass rates between genders in the first and second attempt: the pass rate for female students was only 32 % compared to 46 % for their male colleagues. There was also feedback from female students to staff about problematic challenges during this first-year experience. In addition, the number of women starting the physics course was low, only 17% of the first-year students in 2020 (e.g., 45 out of 250). These factors raised concerns and questions, and an investigation was undertaken in 2019 to examine the first-year learning experience and to identify if there were issues that could be influencing the gender imbalance in pass rates. The study involved 21 interviews of randomly selected students (11 women and 10 male students) who had successfully completed the first year in the last 12 years.

This article describes the outcomes of these interviews, and the measures that resulted from this study. The interviews showed a distinct difference in experiences of the genders in the first year, and a consistent highlighting of problematic issues in the learning environment. In 2020, changes to the first-year physics learning environment followed, with a particular focus on a project to improve the situation for the female students. First, a peer-mentoring program was established for first-year female physics students. We report on how and why we established the program, the events that took place during the academic year 2020/2021 and present the evaluation data. Second, a number of changes were made to the physics lectures and exercise classes in 2020, which were designed to improve the learning environment for all. Finally, and in parallel, an anonymous grading system was introduced, to ensure that the differences in pass rates were not affected by unidentified biases. The paper concludes with a reflection on the impact of these multiple measures, an outline of plans to expand peer mentoring to all first-

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year students, and the importance of an ongoing evaluation to examine the effectiveness of the changes introduced.

Introduction

The undergraduate Physics program at ETH Zurich starts with the "Basisjahr" during which the first-year students' study together with the mathematics students. The first year is intended to bring all students to the same academic level, whether they come from varying specialisms in high school, different countries, or have different prior knowledge. Everyone is given the chance to study physics, as there is no selective entry. However, they must pass the "Basisprüfung" at the end of the first year to continue with their degree. The entry procedure at ETH contrasts with other universities, which have entry exams, or require minimum grades at the end of high school study, to be allowed entry to physics. Each year a large number of students start physics (in 2020 it was 245 students) (Figure 1a), and many drop out or fail the first year. This paper outlines how a study of the first year in D-PHYS came about, the factors and issues identified, and how this led to initiatives to improve the situation in the first year for female students and the learning environment in general.

In 2016, the Department of Physics, after examining the challenges of the first-year study, decided to split the "Basisprüfung" (ETH pilot programme) from having all eight exams held at the end of the summer semester, to setting the first three exams after the Fall semester and the remaining five at the end of the academic year. The idea was to reduce the pressure on the summer exam session and to provide the students with an early feedback. However, the evaluation report on this measure showed that the failure rates of female students in comparison to their male colleagues increased significantly afterwards (see Figure 1b). A difference in pass rates between the genders existed since 2009, but the gender differences increased after the split exam initiative, and in 2016 and 2017 more than 40% of female students failed (Rütsche et al. 2019). In addition, there had been verbal feedback from female students to staff members about problematic challenges in the learning environment during their first-year experience. A small working group was founded to seek to identify underlying causes and potential differences in their experience, which might be affecting the results of the female students.

As a first step, confidential interviews were designed and conducted with 21 students and graduates from different genders, years and background. We used open-ended questions, which enabled the participants to speak about their first-year studies freely. We wanted to identify if there was a difference between the male and female experience, and also to find the common themes. The interviews showed that all of these students described the learning atmosphere as very challenging. The female students, however, were much more affected by the environment, isolation and the impact of failure, than the male students. This led to two of the initiatives that will be presented in this article: the establishment of a peer mentoring program for female students and a number of adaptations to the first-year physics lecture program. In parallel, an anonymous grading system was also introduced into the first-year courses.
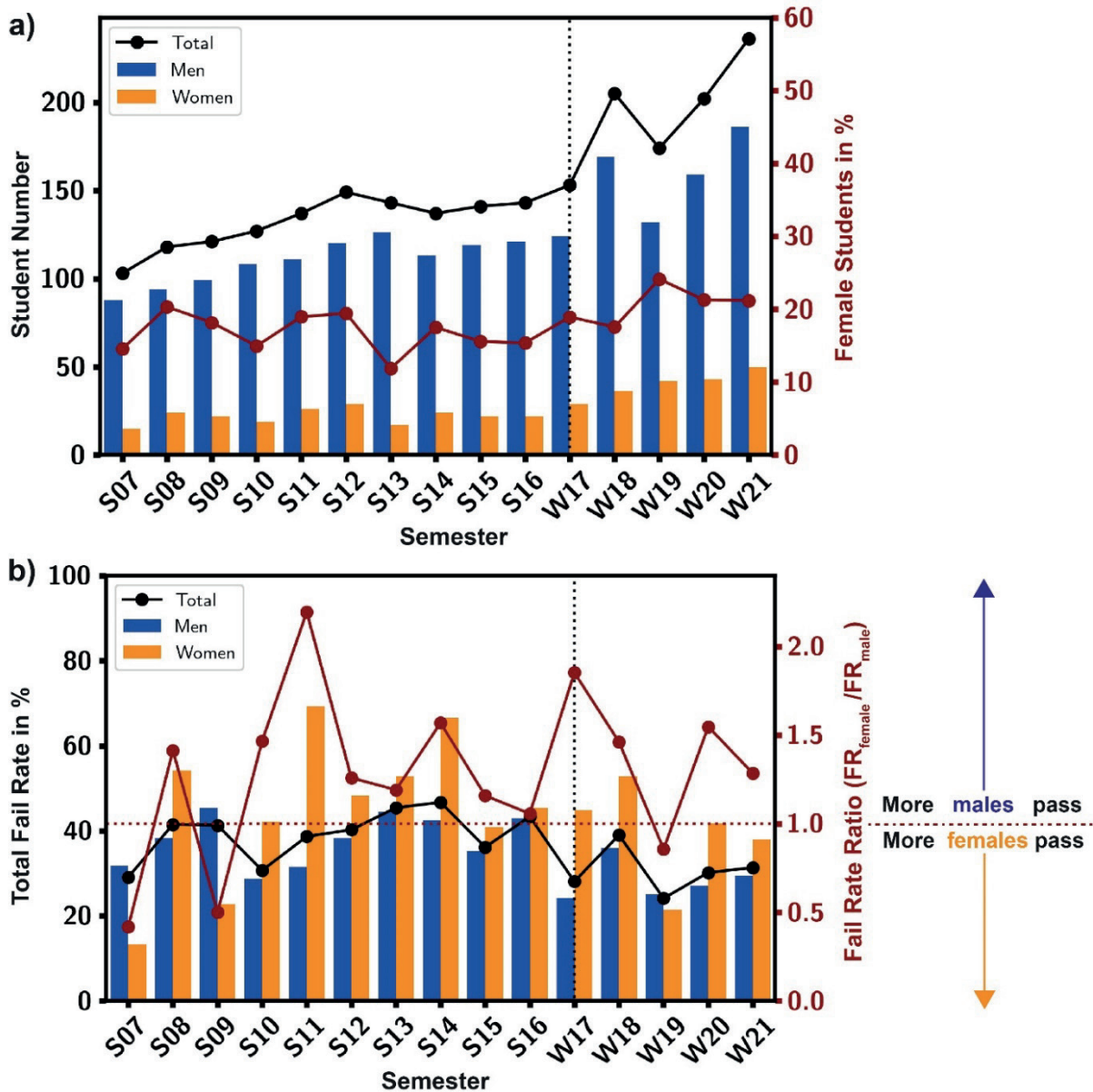
Figure 1: Student Number and Failure Rate a) Number of male (blue) and female (orange) Physics students since 2007 and the corresponding percentage of female students (red, right axis). b) Total failure rate of Physics students at Basisprüfung in % (black, left axis) and corresponding ratio (red, right axis). Percentage of male failed at the first attempt in the Basisprüfung (blue) and of female (orange). Values above 1.0 mean that more males pass and values below 1.0 mean that more females pass.

Interview Evaluation and Suggested Measures

The students interviewed had all successfully completed the first year in Physics at ETH Zurich, their starting dates ranged from 2008 to 2017. Some interviewees needed to take the first year twice. We spoke to bachelor and masters' students, PhDs and Postdocs. The 21 interviews were with 11 female and 10 male students. This was a qualitative study, undertaken in order to identify potential issues, whether in the teaching and the learning environment, or related to gender issues.

The interview questions were designed to make no assumptions about the first-year experience or gender differences, but rather to focus on aspects of the first-year course in general for example: "Describe how you experienced your first two weeks on the physics

course and in the exercise classes?", "What was the student environment like?" or "What contributed to you passing or failing the Basisprüfung?"

All interviewees gave feedback on a number of challenges in the teaching and learning environment. For example, concerning the lectures, students appreciated that there was an established curriculum in Physics, which stayed constant over many years. However, when the lectures depended mainly on the personality and approach of differing professors there could be a negative impact on the learning outcomes and student exam success. Many interviewees reported that there had been a culture of teaching only to the geniuses; and this was perceived as demotivating and intimidating. Certain professors had stated this aim specifically, alongside the comments like "only 50% of you will be here next year." All students spoke about the lack of an introductory period and the overwhelming start to the lecture program.

Criticism was levelled at the exercise classes that accompany the lectures, both in terms of content and the level of teaching. A major criticism was about the excessive time that it took to solve the exercise sheets related to each class. For example, in the Analysis course, it took even the very good students a minimum of eight hours per week to do the exercises. In addition, it was not possible to understand or solve the questions asked in the exercise sheets in all classes without an explanation from their assistants. Plus, the students experienced very different levels of teaching quality between different exercise classes and assistants. A further pressure came from the fact that the Basisjahr can only be repeated twice, two failures means that you cannot study physics at any other university in Switzerland.

On a positive level, the Department of Mathematics and Department of Physics offer jointly a study center since 2015, where students can solve their exercise sheets with colleagues and ask questions to teaching assistants[5]. This center was considered to be extremely helpful for the students, because it provides the possibility to get individual feedback to a student's problem. In addition, the student association (VMP) was explicitly pointed out as very useful and helped in many ways to make students feel welcome in their studies.

However, the interviews did reveal gender differences in the experience of the first-year students. Most female students were affected by what they described as a competitive and unwelcoming environment and by male colleagues who went around saying how great they were and how easy the first year was. Very talented women, who had been top of their school classes, were deeply affected by the abrupt change in their experience of being excellent at school, and of entering an unwelcoming, alienating and intense environment. They described a serious impact on their self-confidence, creating a fear of failure which made them doubt their abilities, and which intensified their reluctance to ask questions so as not to appear stupid. Many woman students spoke of the overwhelming start, with little introduction and perspective, and how awful it was for them to admit when they were in difficulty and ashamed to reach out for help. Top male students struggled with this adjustment to university too, but their self-confidence was unaffected. The male students outlined how they took the difficult year step-by-step and even if they failed, they described the year as painful, needing to be better organized, or better taught. The male students insisted on having extra-curricular activities while most women were more likely to give up their free time activities for constant studying. A further factor that impacted the female students was the heavy dropout rate of their female peers, which added to loneliness and isolation (Marshman et al. 2018).

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[5] An article about the Study Center can be found on page 13 of the ETH life magazine of September 2016: https://ethz.ch/content/dam/ethz/associates/services/News/life/ausgaben/deutsch/eth_life_16_3_DE.pdf

Multiple recommendations from the interviews

Based on the outcome of these interviews, the working group discussed a number of measures which could be implemented practically to improve the learning atmosphere in the physics studies for everyone. One early idea was to introduce a pre-study welcoming week with group forming activities and pre-math courses that could give the students the feeling of being welcomed, find friends and adjust the different prior knowledge levels before the course started. Also, we suggested that adjustments could be made to the introductory weeks of the courses giving the students time to adapt to the new system and the new ways of learning. The exercise classes, sheets and teaching could be restructured. However, as the starting point of the study had been to examine the experiences of the female students and, given the differing impact of the experience and the exam results, a support measure for them was deemed to be a priority.

All interviewees spoke of a challenging and unsupportive learning environment, but the impact on the women students needed to be addressed. Examples from US universities show that making the learning environment deliberately welcoming for all groups increases academic success and participation. For example, Harvey Mudd College[6] in the US has increased its gender representation, and successful performance with specific inclusive measures, creating a welcoming learning environment for all, which resulted in graduating 50% male and 50% female physics students since 2016 (Harvey Mudd College 2018). Research also shows that in physics, women can be struggling not only with self-confidence issues, but the phenomena of "stereotype threat"[7] that comes from feeling out of place, and self-doubting in an environment, which is traditionally populated by male students, and as a consequence underperforming (Johnson 2013). The working group therefore recommended the immediate implementation of a peer mentoring program for first year female students, given that it was clear the women students needed support and networking in the learning environment.

However, given the commonality of the feedback about problems in the learning environment, we also argued for the introduction of wider adjustments to the lecture program outlined above. There is always the possibility that female-only initiatives can lead to a backlash from the other students or lead to the women feeling disempowered by having to receive special treatment. It was, therefore, extremely positive that a number of the additional measures to improve the learning environment for all were implemented immediately, and in parallel, with the new mentoring program. With the support of D-PHYS and the two National Centres of Competence and Research (NCCRs) it was possible to implement two significant measures in 2020: the establishment of a peer mentoring program for female students and a number of adaptations to the first-year physics lecture program.

Establishment of a Peer Mentoring Program

The Departments' conference approved a peer mentoring program for first year female students in Spring 2020. In designing this program, and arguing for its implementation, we had explored initiatives to support female physics students at US universities such as MIT, Yale, Stanford and UCLA. We also examined research that showed the effectiveness of introducing such peer mentoring programs in STEM fields (Zaniewski & Reinholz 2016). We learned some practicalities from a similar program established in 2016 at D-MAVT at ETH (ETH Zurich/D-MAVT n.d.). It was always intended that a focus on the female students would be a first step, and if successful, the program would then be extended to all first-year students.

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[6] Harvey Mudd College is a private university in the US, whose President Maria Klawe (since 2006) is an advocate for supporting diversity and women in STEM subjects.

[7] Prof Anthony Johnson, University of Maryland, defines Stereotype Threat as "the anxiety people experience when they fear that their academic or job performance might confirm a negative stereotype about their gender or ethnic group."

The first action was to set up an information and registration webpage to contact and inform both possible mentees (female students starting their first year in Physics) and mentors (female bachelor, master, and PhD students). The webpage design went through a consultative process, involving the student associations, VMP and Phimale[8]. VMP had established a peer mentoring program for all students in 2012 and we ensured that information on the existing VMP program was cross linked to the new D-PHYS webpage. The plan for the academic year was to match mentors and mentees, facilitate a regular one-to-one meeting process and organize a number of networking events throughout the year.

The webpage[9] includes the purpose of the program, a brief description of the content of the program (events and activities), registration forms for mentees and mentors respectively. It is also illustrated with regularly updated welcoming photographs of women networking (ETH Zurich/D-PHYS n.d.). Considerable thought was invested into a user-friendly registration process for mentors and mentees, and how they might be matched and connected. The university is a multilingual environment, attracting students from neighbouring countries. The online registration questionnaire asks potential mentees or mentors to give information on mother tongue, hobbies, specialism in secondary school, origin and on their expectations of their role or their mentor's role. Mentors were asked to specify how many mentees they would coach.

The program began in Fall 2020 with two email invitations sent: one to all new first year female students and the second to the potential female mentors in D-PHYS. Initially more mentors signed up than mentees and the registration remained open to incorporate latecomers. 44 mentees, which is almost all of the new female students, and 43 mentors from D-PHYS signed up to the program. Just before the semester course began, the students were matched to their mentor and entered the program.

It was originally planned to run this whole program face-to-face, but many of the offered activities had to be adapted to the ongoing Covid situation. The new adaptations were developed spontaneously to give better support to the participants in the online world. For example, the program organizers set up an online/open-source chat platform ("Element") at the beginning of the semester to enable the mentors and mentees to get in contact quickly and to ask and answer questions regarding their studies or life in Zurich: such as "Which is the most helpful book for Analysis?" or "Where are the best parties in Zurich?".

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[8] Association for Mathematics and Physics Students (VMP) has been established for more than 75 years. https://vmp.ethz.ch/en/home/. Phimale, the association for female Physics students, was established as an association for equal opportunities, as part of VMP in 2017, http://phimale.ethz.ch/

[9] The webpage of the peer-mentoring programme can be found here: https://www.phys.ethz.ch/studies/mentoring.html (accessed 30.08.2021)
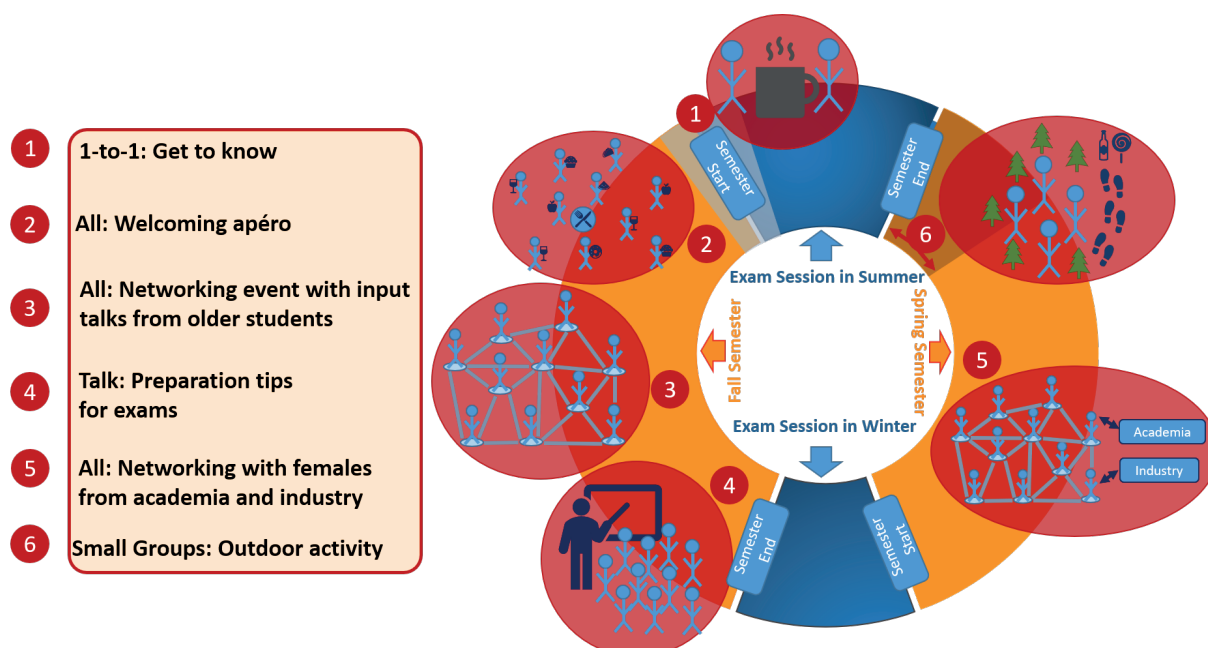
Figure 2: Layout of the Mentoring Program The first year is divided in two semesters (orange), Fall and Spring, and two lecture free periods (blue) during which the exams take place. Full details of events 1 to 6 are in the text.

We encouraged the mentee and mentor to meet at least once per month. To support the individual meetings, we planned six activities to take place throughout the year. Figure 2 gives a visual schema of the program, with the activities organized throughout the year. It was intended that one activity would be organized by the student associations, but the Covid pandemic changed the structure of the programme. Each event is summarized below giving its purpose and implementation details for each event.

1. **Get-to-know:** Coffee vouchers were offered to the participants to encourage them to meet as soon as possible at the ETH campus restaurant. They could post about the meeting on the online platform to inspire the others to go for coffee together, and to establish the community spirit. Most of the mentee-mentor-pairs met before or just shortly after the semester start.

2. **Welcoming apéro:** We were able to host an in-person apéro shortly after the semester start. The COVID-situation required strict measures and that the event take place outside. It took place on a sunny day, attended by the mentees, mentors, the program sponsors and organizers and the professor who taught their first physics course. Small details were important: a welcome speech, name tags for all, a get-to-know someone game (participant number: 51).

3. **Networking event with input talks from older students:** The second event had to be organized on Zoom, because of the worsening Covid situation. Two students shared their personal stories to give the first semester students an insight into the experiences of the older students. The purpose of the event was to network, to enable questions on study challenges: a Zoom poll was used for interactivity, and two sessions of break-out rooms enabled the attendees to network and exchange with each other (participant number: 27).

4. **Preparation tips for exams:** Before the exam winter session (Jan 2021), Viola Vogler-Neuling (program organizer and also former exam corrector) organized an online meeting presenting the structure of the exams, some tips how to go about exam preparation and how to take them successfully. The first semester students had the opportunity to ask questions (participant number: 32).

5. **Networking with women from academia and industry:** During the Spring 2021 semester three women from academia and industry were invited to a networking event online. The women presented their career paths to the program participants and gave insight into their successes and struggles. It was a lively and interactive event (participant number: 28).

6. **Outdoor activity:** The last event was a treasure hunt held outside to be performed in pairs or small groups. The location of the treasure hunt was the Hönggerberg campus, i.e. it was not required that the women travel or take a long time off to participate and it fit the ongoing Covid restrictions (participant number estimated to be 20 as no registration was required).

The participation in the program was steady, and an evaluation process was designed to gather information on its impact, failings and to learn lessons for any continuation of the program.

Evaluation of the Program

We set up a first online evaluation survey at the end of Fall 2020. It was important to get feedback early, because most interaction was online, with participants working in home office. There were 35 respondents and we could see the level of engagement, participation in the activities and received feedback on issues related to the online platform, and the Covid regulated apéro. It was positive to see how many mentees and mentors had connected.

At the end of the academic year 2020/2021 we sent out a second online survey to gather feedback on the mentoring program. 37 participants responded to the survey; 50% were mentees and 50% mentors. The survey was designed to evaluate successes and problems under the following themes; how often our pairs met, how they rated the way they were matched, the experience of the organized events and how it was to be a mentee or mentor. Were there some missing aspects in the program? We learned that on average the mentees/mentors had 3 one-to-one meetings over the year, but some met as many as 14 times. The matching characteristics in terms of age, study-type, matching ideas on work-life balance and future perspectives were the highest rated for making a successful pair. Feedback on the organized events was very positive, but respondents would have preferred in-person meetings. The exam tip event was vital to some mentees, while all appreciated the networking. There was differing feedback depending on whether you were a mentee or mentor. Mentees dropped out of the program if they changed course, or failed their exams, but all wrote of feeling in good hands, supported and reassured. Mentors enjoyed supporting the mentees and dealing with challenging questions. It was sad to deal with the experience of their mentee leaving the program, sometimes with no explanation. The mentors benefited from the women in industry event and would like an introductory event, before the program starts, to advise them on their roles.

Longer term evaluation of the program, and its impact on female students, will be necessary. Given that the peer mentoring program will be continued and extended to all first-year students in Fall 2021, all lessons learned and feedback from this first year will be passed on to the next stage, with the aim to continue monitoring and evaluating the impact of a peer mentoring program on the first-year students, specifically the minority group of female students and their subsequent exam results.

Adaptations to the First Year Physics Course

Many findings from the interviews led to immediate changes to the Physics 1 course in Fall semester 2020. Physics 1 has weekly lectures of two times two hours over 14 weeks, taught by the professor. The lectures are accompanied by exercise classes, of two hours, taught by the teaching assistants (TAs), and one TA also is present at the Study Center once a week. The course adjustments involved changes in the lectures, development of a new strategy with the exercise classes and sheets, and a specific briefing meeting of the teaching assistants for the course. All changes were designed to improve the teaching and learning environment for first year physicists.

The adjustments can be classified into three categories: First, there is a long tradition and belief in the student community that the first year is designed solely to fail 50% of the students. This influences the learning environment negatively putting pressure on all students and if, added to this, there is the myth that only geniuses can pass the first year, then the learning environment is neither inclusive nor supportive. The first step was to make very clear that the purpose of the first year is to bring students to the same level of knowledge, given their range of backgrounds and prior knowledge. No one should say (as had been said in past years) 50% of you will fail, or that the course was "trivial." An informal meeting between the students and the professor was held to create a friendly environment from the beginning.

Secondly, the structure of the exercise sheets was analysed and adjusted, based on the feedback that there is an overwhelming learning experience at the beginning of the course. There were a number of new features. The sheets were embedded in the broader course context by having a learning goal attached to each sheet. Then sheets were designed deliberately to build up gradually the application of knowledge and skills presented in the lectures. Each sheet began with the easiest exercise giving the students the time to practice. In the first three weeks students had to solve only 3 exercises per week, increasing the number to the normal 5 exercises after that. Students were also informed that they could change exercise classes if the one they were assigned to was not suitable.

Thirdly, the teaching assistants (TAs) were given information and support before the course started. Many PhD students have not studied at ETH and do not understand the purpose of the Basisjahr. They were advised on the outline of the course, what was important to create a good learning environment, and recommended to attend the ETH "Learning to Teach" course for TAs. A list of "dos and don'ts" highlighted common demotivating mistakes, such as diminishing the difficulty of the task and preventing students from asking questions. An additional support for exercise classes was also introduced, where the TA visiting the study center, provided the other TAs with information on the common student problems of the week, one day before their next exercise classes.

The fact that the outcomes of the study could be implemented so quickly into the next semester's course was related to the great investment made in innovation by the responsible professors, and the dedication of working team members in D-PHYS.

Introducing an Anonymous Grading System in Physics 1

Independently from the initiatives discussed above, it was decided to introduce an anonymous exam system for the first-year physics course as a response to the analysis of the exam results published in 2019 (Rütsche et al. 2019). The aim was to ensure that the gender differences in the exam results were not due to any bias on the part of exam correctors. Anonymous marking was implemented for the last three Physics-I exams (W20, S20 and W21). A further reason was to demonstrate to all students the commitment of the Department to an unbiased treatment of the assessment process and reducing the impact of extraneous factors on the assessment.

In the new system an exam dossier consists of an envelope labelled with an individual exam number, containing a cover page, the exam questions and a formulary leaflet. Students were required to enter their full name and their personal student ID number on the envelope and cover page only and to label their submitted answer pages with the corresponding individual exam number only. At the end of the exam, the students were asked to insert the cover page, questions sheets and their answer pages back in the envelope. After collection, the exams were scanned by an independent individual, who then separated envelope and cover page from the question-and-answer pages. The latter were transferred to the correction process. Each question was corrected, double-checked and marked by a team of 2-3 teaching assistants who had been involved in teaching exercise classes for the lecture. Grading was done, after counting the total score, but before the exams were re-assigned to the student's personal ID number.

In many universities internationally, anonymous marking is now the norm. In Sweden, for example, all universities use this approach; the University of Lund established an anonymous marking system in 2015 (Lund University/Faculty of Engineering n.d.)[10]. There is ongoing research about the impact and efficacy of anonymous exams on performance (Hinton & Hinson 2017, Akveld & Luethi 2022), with more findings expected in the future. In the meantime, it is helpful for minorities to know that stereotypical views have been removed from the assessment process, perhaps also reducing stereotype threat.

A first analysis of student failure rates in 2020/2021
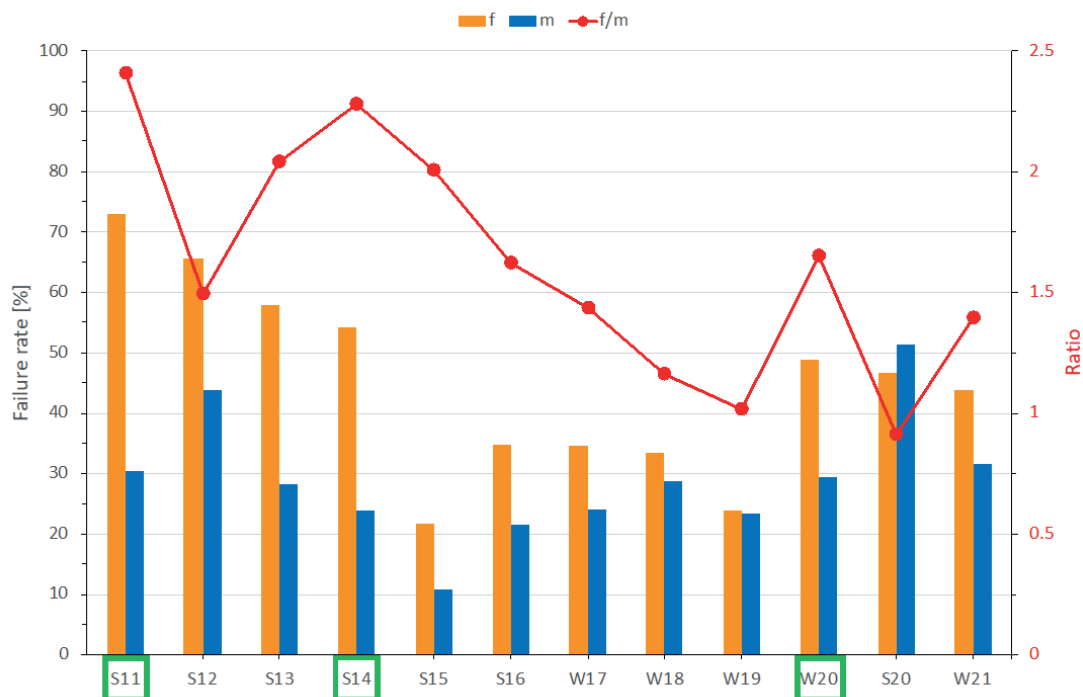
Figure 3: Failure rate of Physics students at the Physics 1 exam over the last 10 years (females in orange and males in blue). The ratio between the failure rates of women and men is shown in red (right axis). The years with first time lecturer are indicated by green squares.

Figure 3 displays students' failure rates in physics in the last 10 years and shows the ratio (FR_female/FR_male) of failure rate (FR) between women and men. When focusing on 2020/21 the absolute differences (|male-female|) in % are as follows: 19.3 % in W20 (202 students) and 12.4 % in W21 (240 students) compared to the 10-years average of 18.2 %, without implementation of anonymous marking (Figure 3). For students in mathematics, the difference between women and men was 19.9 % in W20 (157 students) and 17.6% in W21 (155 students) compared to the 10-years average of 19.3 % without anonymous grading. Perhaps the anonymous grading format had a limited effect on gender difference, but it is very important to test this assumption over a longer period.

In addition, in W21, the gender difference decreased more between students in physics than between the math students (compared to W20). Is this the result of the peer mentoring program introduced in W21 for female students in physics? This program was not available for male physics students nor math students.

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[10] University of Lund introduced anonymous marking in 2015.

Interestingly, the gender difference in failure rates was reversed for S20 for the first time in 10 years. The change during the Covid lockdown in spring 2020, when much of the learning process was online, led to a difference of 4.6 % for the Physics exam in S20 in favor of the female physics students and 5.6 % in favor of the female math students. A change in the learning setting and the gender difference was canceled or even reversed. In S20 only the written exam was on-site. Is it possible that women suffered less without the negative experiences of the learning environment in this semester and exam preparation? Another hypothesis is that women dealt better than male students with the difficult situations arising from Covid and could get better organized.

The analysis of the gender differences of the Physics 1 exam and the "Basisprüfung" is only at the beginning. It should also be noted that the accuracy of analysis is also difficult to establish, because the teaching teams for each course change on almost a yearly basis, which increases the parameters influencing the pass rates. One factor that has been observed is that failure rates in general were always highest in the years where the teaching team was new (green squares in Figure 3). In their successive years the failure rates were decreasing.

Conclusion and Outlook

This paper has outlined responses to a study initiated by D-PHYS in 2019, driven by a concern for gender differences in the exam results at the end of the first year, and negative verbal feedback from female students to staff members on their first-year experience. The study confirmed the concerns and, supported by the department, the two NCCRs and involved professors, it was possible to implement a number of measures quickly in the subsequent academic year of 2020/2021. The implementation of measures both to improve the learning environment, and to support the minority female students has only just begun. The female peer mentoring program was embedded within wider goals, and long-term objectives, to improve the first-year learning experience for all students.

The evaluation processes for the first peer mentoring program for female students indicated successful participation from mentors and mentees, with some suggestions for amendments, particularly that networking would be better face-to-face, once we are through the Covid pandemic. These two evaluations were first steps, and the evaluation process needs to be continued into 2021/2022, when a peer mentoring program in the first year will be extended to all new students, with the support and resources from the Department of Physics.

A first analysis of gender differences in the failure rates between male and female students in the first year was made, using the latest exam results, but a deep and lasting analysis of the changes in yearly results will take time and further investigation. It needs to be an ongoing process to assess the impact of the introduction of new measures to improve the learning environment, the establishment of the anonymous grading system, and the specific support for female students. A change in the gender differences of the exam results has been observed, but it is difficult to identify what brought this about: changes to the learning environment, the peer mentoring program for female students in physics – and there is a difference in results between physics and math – or some impact of the online teaching and learning environment during the pandemic.

One concern that set into motion the original study, was to identify if the first year in physics at ETH was a difficult environment for young women physicists. While only based on a relatively small cohort, these interviews did clearly identify challenging experiences for all female students interviewed and, for some, it was a time when their confidence was destroyed. The fact that all the interviewed students identified problems, lead to a focus both on what could be done in general to help students and, at the same time, to provide support for the women

students. Emphasizing only a minority's status and presence can add to factors such as "stereotype threat" or jealousies if all students are struggling in a challenging academic year, but only one group is supported.

Now that the peer mentoring program will be extended to the whole student group in the coming academic year, the impact of this program on all the students, and the learning environment, needs a next-stage evaluation. As part of this evaluation, it will be important to investigate if there are any losses to the minority group of women, through the extension of the program to the whole cohort. The D-MAVT's peer mentoring program for female students has only recently been extended to all of their first-year students; it may be that lessons can be learned and shared across the departments.

Ongoing investigations of exam results will continue, to identify the longer-term impact of the measures introduced into the first-year learning environment. It could also be useful to connect this analysis to the results of the regular student evaluations of the first-year lectures and courses. It might also be enriching to connect the work in first-year physics, with the ongoing exploration and development of the curriculum in first year D-MATH courses (Akveld & Luethi 2022).

In conclusion, this paper has reported on how a 2019 study of the first-year physics experience resulted in the introduction of a range of initiatives and measures in 2020/2021. All three initiatives were aimed at improving a learning culture for the young students in the department. As the changes continue to be embedded and expanded, the evaluation process should continue over time. A future quantitative study of student experiences could be undertaken and would be very valuable, to check the impact of introducing these measures on the current and next cohorts of students.

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A Case Study: The D-MAVT Mentoring Programme. From a women-only project to peer-to-peer mentoring for all new students.

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Abstract

The peer-to-peer mentoring programme of the Department of Mechanical and Process Engineering (D-MAVT) at ETH Zurich started out as a way to support young women and thus promote and retain talent. Despite various efforts, the percentage of women in this department is increasing only very slowly. The mentoring programme, first introduced in 2017, was intended to facilitate the start of their studies. Regular surveys among participating mentors and mentees confirmed the success of the programme. However, it also became gradually apparent that mentoring for all could be even more promising. On the one hand, both men and women struggle with the same initial challenges. On the other, the extension of the programme would forestall any criticism or feeling of neglect/discrimination on the part of male students. Above all, it would also prevent women from being seen as needy – a perception which was the exact opposite of the programme's goals. Today, D-MAVT mentoring includes first-year students of both genders. To further professionalise the programme, in 2021 D-MAVT organised its first ever kick-off workshop for all mentors. More ideas to improve the D-MAVT mentoring programme are being developed continuously based on regular surveys and dialogue with the students.

Introduction

The biggest hurdle for most students in the Department of Mechanical and Process Engineering (D-MAVT) at ETH Zurich is making it past the first year. Everything is new, and much more personal responsibility is required than at secondary school. The first few weeks in particular are crucial, since students need to get their bearings, sign up for their courses and make sure not to miss any deadlines. They have to establish new routines and make new friends, while some also find themselves living in a new location. On top of that, students face highly demanding examinations at the end of the first year and cannot continue their studies unless they pass.

Some students fail in the first year not because of a lack of skills and aptitude, but because they are unsure of what to prioritise or put too much pressure on themselves. Female students are at even higher risk than their male peers in this regard. Since women are a distinct minority, accounting for only 10 to 12%[3] of all first-year students at D-MAVT, they often – consciously or subconsciously – feel the need to prove that they have earned their place. This increases

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the pressure and, as a result, they tend to do poorly on the examinations even though they have the necessary skills and work ethic to succeed.

The management of the MAVT department has been aware of this situation for some time and has therefore tried various measures to support female students and increase their numbers. It should be stressed that D-MAVT strives to keep all potentially good students who are simply struggling with the adjustment to their new environment. Diversity, however, is one of the elements, which increases the overall quality of research, teaching and studying.

D-MAVT has been taking various steps to encourage diversity. For example, the department has adapted its strategy to focus more on promising female scientists worldwide in order to hire more female professors. It also specifically targets girls in schools, running various workshops to encourage them to consider studying a STEM (Science, Technology, Engineering, and Mathematics) subject. D-MAVT also ensures that women and men are represented equally in its communication and provides financial support to the student organisation "Ladies In Mechanical and Electrical Studies" (LIMES) and reports on its activities.

Development of the mentoring programme

To further support female students starting at D-MAVT, the department established a peer-to-peer mentoring programme for first-year female students in 2017 in close cooperation with LIMES. The programme is implemented by D-MAVT's PR & Communications team in close cooperation with the D-MAVT Student Administration. While the PR team promotes the programme and is responsible for its organisation, the Student Administration supports the programme by providing organisational details, for example about timing, and contact details for the students and informs first-years students about the programme at various events.

The implementation of the programme was preceded by in-depth discussions with female students from LIMES, members of ETH Zurich's Equal team, staff from D-MAVT's communications team and its student administration. The students from LIMES were convinced that most students would be eager to assist the newcomers and did not see this as an additional burden. Another question discussed was whether male students should support female first-year students. In the end, the general consensus was that women often speak more openly if there are no men present. However, it was agreed that this aspect would be re-evaluated in the future. After all, supporting a female student could also increase male students' understanding of women's situation at D-MAVT and vice-versa. In addition, many questions about studying in the department could be answered just as well by men as by women.

To start-off with, the following approach was chosen:

- Participation for the new female students should be voluntary.

- To inform them, the programme would be promoted at ETH Zurich's pre-study events.

- Registration would be set up on the D-MAVT website, including additional information.

- All mentors should be senior female students from D-MAVT who had passed the first year examinations. Their involvement should also be purely voluntary and should not be compensated financially.

- To contact potential mentors, D-MAVT Student Administration would approach all female Bachelor students by e-mail and ask them to register via the D-MAVT website.

- Each mentor could support up to three mentees, since everyone agreed that supporting the new students should not be very time-consuming.

- Everyone – mentors and mentees – would be asked to comply with the Code of Conduct of ETH Zurich.

To kick off the mentoring programme, a small informal get-together with the mentors and mentees at the start of the new semester was planned for October 2017. LIMES was in charge of catering, while D-MAVT organised a number of short lectures. There was a general presentation on the mentoring programme, and in addition a graduate student was invited to speak about her career and her experiences at ETH Zurich. This get-together was intended to provide a relaxed setting for mentors and mentees to get to know each other and thus further contribute to a successful start for the female students.

To assess the success of the programme an online questionnaire was prepared and sent to all mentees and mentors at the beginning of the first-year students' second semester.

Evaluation of the first mentoring programme

The evaluation of the first mentoring survey early in 2018 revealed that mentees and mentors alike appreciated the initiation of this programme. Just as intended by D-MAVT, the first-year students used mentoring primarily to obtain practical tips on studying and on preparing for the examinations. The mentees also exchanged information with their mentors about their personal experiences at the university. The majority of mentees were in contact with their mentors 1 to 4 times. Both mentors and mentees found the programme to be effective and not time-consuming.

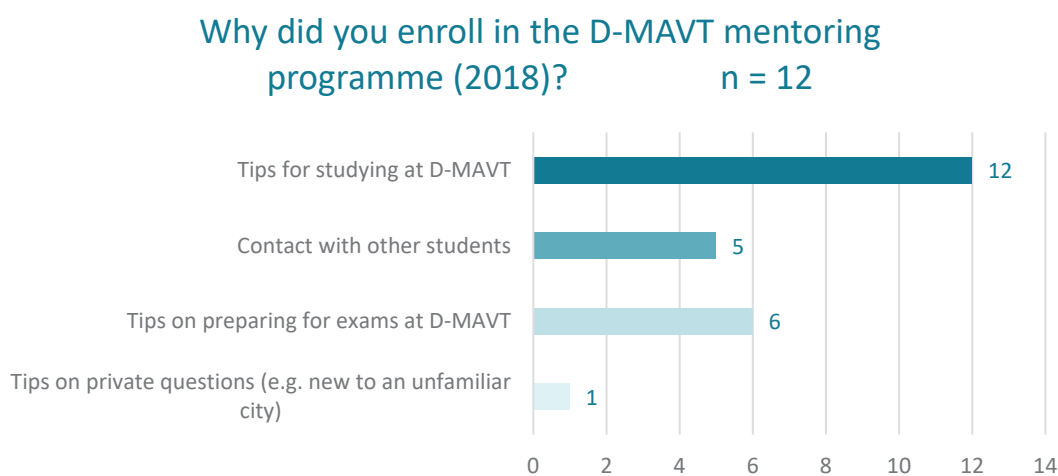Results from the initial mentoring survey in 2018:

Figure 1: Enrollment to the mentoring programme of D-MAVT.

In what ways were you able to benefit from D-MAVT mentoring programme (2018)
n = 12
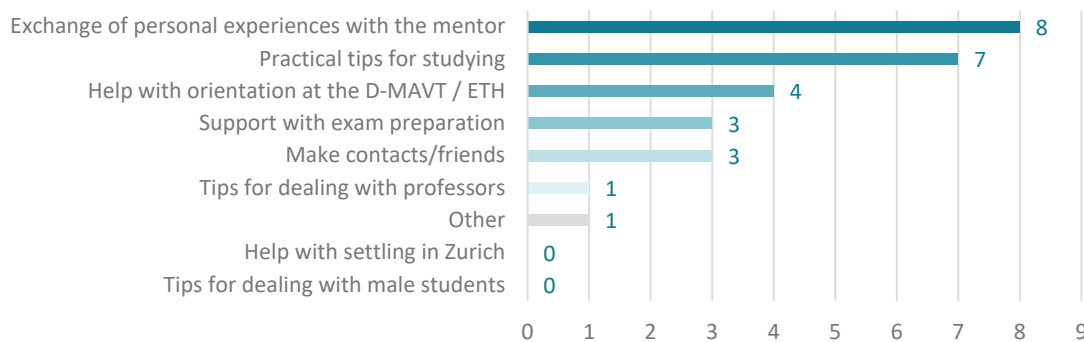
Figure 2: Benefits from participating in the mentoring programme at D-MAVT.

Despite the success of the first mentoring programme, D-MAVT decided to make minor adjustments for the next round in the autumn of 2018. Since the survey had also revealed that the newcomers needed the most support in the first couple of days before the start of the semester and in the first few weeks after, the get-together was moved from October to September for the coming mentoring programme.

Re-evaluating the programme

After the successful second round of mentoring in 2018, D-MAVT wanted to further professionalise the operation and visibility of the programme. To this end, the communications team worked with a young, female graphic designer to develop a logo. The designer opted for a stylised figure in eye-catching pink and orange. In addition to promoting mentoring, this colour scheme was intended to make women more visible in the department. The stereotypical pink - softened by the orange - was chosen deliberately to signal that there are many talented women in mechanical engineering.

Before the logo was used, the communications team consulted LIMES, which was still its project partner. However, the logo met with strong disapproval. To find out the reasons for this rejection, D-MAVT sought dialogue with LIMES. In addition to conversations with LIMES members, D-MAVT also held qualitative interviews in the department with other female students from different semesters to gain a broader perspective. In addition, the surveys were reviewed again, in particular with regard to the personal comments from mentees and mentors.

The goal was to
a) find out why more visibility of women met with rejection, and
b) how to go forward with the mentoring programme.

During those interviews, members of LIMES and other female students voiced – for the very first time – their biggest fear that any visible support for women would single them out and make them appear weak to their male peers. In addition, they were afraid that their male peers would envy them for having a support system to which they did not have access. Although all women were clearly in favour of mentoring and found it very helpful, they feared that it could trigger a negative reaction from male students.

The conversations with the female students also explained why a different room for the get-together had been requested in the survey every now and then. D-MAVT had previously assumed that the entrance area of the ML building had not been so well received because the space was not all that modern. However, the issue had been the fact that a gathering in this

place was very visible. The women did not want to be seen enjoying an aperitif, which their male fellow students could not attend: they feared that the men would resent it. The interviews also revealed that it is mainly thoughtless remarks and the sheer number of male fellow students, which intimidate young women and can negatively impact their performance. One of them described it quite vividly by evoking a situation in which she – as the only woman – had to enter a room filled with 300 male students.

For some students this discomfort and insecurity apparently go so far that one of them referred to it as an "imposter syndrome"; the feeling that female students are actually out of place in mechanical engineering. According to the interviews, this feeling often develops even before the women enter university; for example, because relatives and friends express astonishment when they state their intention to study mechanical engineering or another technical subject. Critical remarks from male peers and a male dominated environment then reinforce this feeling. As a result, female students feel they have to be twice as good as men.

Although the interviews provided a good insight into the challenges faced by female students, that did not make it any easier to move the programme forward. Many of the problems the young women voiced were very subtle and could not be addressed with regulations such as a code of conduct or with the mentoring programme alone. The fact that visible support for women seemed to run the risk of being counter-productive made it even more challenging.

Tentative steps forward

D-MAVT decided to continue the 2019 mentoring programme with women only and implement it in the familiar format. Only the logo was modified by replacing the pink with the department's official turquoise shade, keeping orange as a contrast. At the same time, concepts were developed step-by-step to address the women's concerns and further adapt the mentoring programme.

The biggest challenge was the large number of first-year students, if both men and women from the department took part in the programme. Around 500 new students start at D-MAVT each September. Even if only half of the freshers signed up for mentoring, this would mean organising a get-together for up to 500 people (mentees and mentors combined). This large number would make personal conversations virtually impossible, not to mention the difficulty of finding a hall of that size and the cost of catering.

The start of mentoring for all

With the onset of the COVID-19 pandemic in the spring of 2020, the entire situation changed. Quite suddenly, a face-to-face get-together for mentors and mentees was out of the question. Organising mentoring for both genders became much easier. D-MAVT therefore decided to implement mentoring for everyone in the autumn of 2020. Remote teaching already made studying very challenging for everyone, so it seemed more than reasonable to offer the mentoring programme to all new students. In addition, the pairing of mentors and mentees would no longer be based on gender, to further eliminate any sense of discrimination on either side.

As before, mentors and mentees could sign up via the D-MAVT website, and they received each other's contact details by e-mail shortly before the beginning of the semester early in September 2020. The pairs were to contact each other within 5 days; the basis remained the Code of Conduct of ETH Zurich.

Evaluating mentoring for all and next steps

260 first-year students and 125 mentors participated in the first mentoring programme for all. The survey, which is conducted every year, revealed in 2020 that the newcomers valued the support through their mentors and that advice on studying was once again the main topic. 90% of the mentees confirmed that their expectations were met.
First survey of mentoring for all first-semester students:
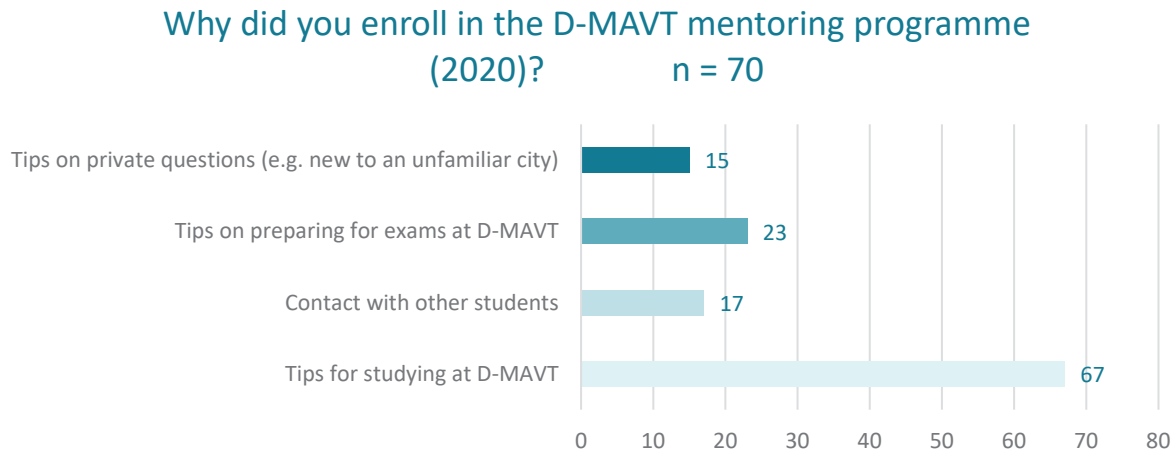
Figure 3: Reasons for enrolment at the mentoring programme.

As in previous years, the survey also showed that mentors were very eager to help the first-year students. Some were even disappointed when their mentee asked very few questions or did not need any help at all. Several mentors expressed a clear desire to be able to support the mentees even more professionally in the future.

Based on these results, D-MAVT further adjusted the programme in 2021 and decided to offer a 1-hour online training course for mentors. The very first online training took place in August 2021. It was voluntary for all mentors and free of charge. D-MAVT partnered with ETH Zurich's Student Services for the training. Student Services provided tips on how to conduct a conversation to identify the mentees' needs more effectively, and two mentors from the previous year reported on their experiences.

The concept of the online training was developed based on experiences with virtual meetings during the pandemic. Before the pandemic, such solutions were not common and it would have been difficult to train a group of prospective mentors from different semesters, who might not even be in Zurich during the summer. In this respect, the pandemic has opened up new opportunities for the development of the mentoring programme. For the future, it is even conceivable that a virtual get-together for mentees and mentors could be offered, which would solve the space and cost problems. Further discussions with all partners involved are needed before this can be implemented.

Objectives and future of mentoring at D-MAVT

Despite the ongoing changes to the programme, the core objectives have always been the same: support for women and the retention of excellent engineering students. The surveys confirmed that support from a peer during the first few weeks as a student is very helpful and that the support is gladly accepted by many newcomers and just as gladly given by older students. Some of the biggest challenges in developing and implementing the mentoring programme remain the subtlety of the challenges for female students and the huge number of first-year students at D-MAVT.

Sensitizing future teachers to psychological research on gender and STEM

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Abstract

What leads less women to pursue STEM careers? What does research find about differences in girls' and boys' educational trajectories? Students and faculty may have heard about gender bias, the leaky pipeline, gender stereotypes, or gender differences in the brain, but it is often difficult to grasp the underlying complexity of these topics. As social scientists in a technical university, we think that learning more closely about research in this field is helpful in developing a balanced and critical perspective. We have thus developed a course on gender issues in education and STEM for students in the teacher education program at ETH Zurich. In this paper, we first introduce some of the main issues in the context of gender and STEM, around which our course is designed. We then describe the pillars of our course. The course is interactive, with students presenting and critically discussing psychological and educational research. We walk students through the various controversies in the field: the nature-nurture question, gender differences vs. similarities, biases vs. interests, gender stereotypes and potential interventions. In a final assignment, students in small groups integrate several papers into a blog-post. Finally, we describe how students respond to our course, and discuss the challenges we as lecturers experience throughout.

Introduction

Why aren't more women in science? is the title of a 2007-published book (Ceci & Williams 2007), in which distinguished social scientists, primarily psychologists, discussed some major and uneasy questions regarding what has become a burning problem in western societies: the underrepresentation of women in science. *Underrepresentation* denotes that compared with the roughly even male / female ratio in the population, substantially less than 50% of the people entering STEM domains (science, technology, engineering and mathematics) are women (OECD 2018). Although more women are in science today than several decades ago, the increase has been uneven across STEM fields. In the most mathematically intensive fields such as computer science, physics and engineering, the proportion of women still stands far below 50% (Cheryan et al. 2017). Such imbalance in gender distributions is prevalent across education levels (from high-school tracks to doctoral studies), with a further drop in the share of women in academic positions beyond the doctoral level (Ceci et al. 2014). Furthermore, universities across countries seem to face this situation, ETH Zurich being no exception (ETH Zurich 2021).

Considered problematic for several reasons, the low participation of women in some areas of science yielded extensive research into understanding its causes and potential ways for change. Academic institutes have become increasingly interested in finding ways to alter the situation, and are implementing various initiatives. Some examples are efforts in making fields

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like engineering more attractive for girls, or searching for female role models in male-dominant fields (Liben & Coyle 2014, Stout et al. 2011). Some of these activities are informed by or even rely on research findings from the social sciences. Thus, it is not unlikely that students and faculty have heard terms such as *gender bias*, the *leaky pipeline* or *gender stereotypes*. Nonetheless, it might be difficult to grasp the complexity of the gender-science issue without knowing about the scope of scientific work done in this context, or without delving into questions such as: What leads less women to pursue STEM careers in the first place? What does research find regarding differences in girls' and boys' educational trajectories before they decide about higher education? We think that learning more closely about research in this field is helpful in unfolding some of these complexities, gaining a deeper insight about them, and developing both a balanced and a critical perspective.

With this goal in mind, we have developed a course on gender issues in education and STEM, which is offered to students enrolled in the teachers' education program at ETH Zurich, whom we regularly teach in our group. Inspired by Ceci and Williams' book, which spans a wide breadth of empirically studied topics and considerable debate, we constructed the course around key issues regarding gender and STEM education. Although research has expanded and findings have been updated since that publication, the main issues remain highly relevant in contemporary research and theory. While we are not covering every possible aspect in our course, the goal is to provide students with a comprehensive view on these matters rather than overemphasize certain factors as "the main reason" a student continues or not in STEM. Since our students are future secondary school teachers, an emphasis is put on linking these topics to teachers' role in the classroom setting. We believe, however, that learning about these topics is relevant to university faculty as well as to other students. In the next section, we briefly review the key topics around which the course is organized, and then go on to describing the course.

Cognitive performance by gender, or "Are boys better in math and girls better in languages?"

Comparing genders on cognitive performance is relevant to many research questions, and is obviously done in the context of gender and STEM. While exploring whether differences exist does not provide us with explanations on their causes or indicate their meaning, it is an important starting point prior to asking any *why* questions. International assessments among school-age children and adolescents find minor or no gender differences in mean performance on mathematics and science assessments, averaged across countries, while a rather consistent advantage for girls emerges on language competencies (Berkowitz et al. 2020, Reilly et al. 2017). The issue of performance assessment is, however, complicated by several factors. For example, the type of assessment matters: there is a tendency for a male advantage on standardized mathematics tests and a female advantage on teacher assigned grades (Miller & Halpern 2014, Voyer & Voyer 2014). The area of cognitive performance matters, with general cognitive abilities hardly showing gender differences, but some gaps emerging on specific abilities, such as a male advantage on certain spatial ability tasks (Halpern et al. 2020). The location of scores within the distribution matters as well, with the weakest differences appearing at the mean level, and more apparent differences at the higher or lower range of scores (Pargulski & Reynolds 2017). Disagreements seem to exist not only regarding the origins of any found differences in performance, but also on what makes a finding practically important or not. A small statistical difference may be viewed as important and highlighted by some, while others find the overlap in scores, and hence the similarity between genders, as the more important result (Hyde 2016, Wai et al. 2018). Thus, a simple answer to whether one gender outperforms the other on some area of cognitive performance is difficult to achieve. While providing an overview of such findings in our course, we point out the importance of these additional factors that come into play. An important message in this regard is that gender

differences in cognitive performance, when found, fall short of explaining the actual male-female ratio seen in STEM areas, indicating that other factors must be at play.

Interests and preferences by gender

An often-made argument regarding the underrepresentation of women in science is that it is not about any disadvantaged ability, but rather an expression of preference. Put differently, it is argued that some STEM fields are just not interesting enough for most women. Research on interests indeed finds substantial gender differences across development. In particular, differences emerge on a dimension termed *people vs. objects*, referring to areas involving social interaction (*people*) as opposed to areas involving inanimate systems of some kind (*objects* or *things*) (Su & Rounds 2015). When given inventories of different occupations, women, on average, show a stronger preference for *people* (e.g., social worker), whereas men show a stronger preference for *objects* (e.g., technician) (Su et al. 2009). Research on children's play preferences from about the second year of life, as well as on preferable school subjects and adolescents' plans for their future education shows analogical gender differences (Ceci et al. 2014, Dinella & Weisgram 2018, Kuhn & Wolter 2020). Thus, at the level of expressed preferences, the answer regarding gender differences seems less ambiguous than for cognitive performance.

Should the discussion stop here then? Should interests be similarly distributed among males and females? We pose these questions to our students, which usually generates a lively discussion. Although we do not argue that interests must by all means be equal across genders, we believe that taking these statistics at face value may quickly lead to oversimplified conclusions such as "girls just do not like physics, it is their free choice not to specialize in this field". A first reason for not stopping the discussion is that gender differences in interests also do not fully account for the underrepresentation of women in some STEM areas (Su et al. 2009). Second, we know that interests and choices are strongly influenced by socialization, which includes gender roles and stereotypes regarding what girls and boys should like or do. These may suppress potential interests in gender-atypical domains, lead to fewer experiences in such domains, or to develop narrow perceptions of them (Eccles 2007, Wang 2012). Furthermore, a drop in women's STEM-participation often occurs after they have entered STEM, hence among women who did have enough initial interest. An important message in this regard is that interests should not be seen as fixed traits that are resistant to change. Rather, interests develop and can be encouraged, and many researchers study ways for doing exactly that (Gaspard et al., 2015; Rozek et al., 2015).

The origins of gender differences in cognitive performance and preferences

Perhaps the most challenging endeavor is to provide scientific explanations for any appearing gender differences in either performance or preferences. The old nature-nurture distinction is often present in this context, namely the degree to which innate, biologically determined factors (nature) influence gender differences, comparing to the shaping power of social, environmental and situational factors (nurture). While nature and nurture are no longer viewed as mutually exclusive, but more often as forces in a reciprocal relation (Miller & Halpern 2014), researchers are still debated over their relative importance. On nature's side, sex differences in the brain (e.g., brain structure, function and development) and sex hormones are sometimes linked with the gender-STEM question. For example, a male advantage on certain forms of spatial ability—which is regarded essential in several STEM areas—has been linked with prenatal hormonal exposure to androgens (Beltz et al. 2020). Some researchers suggest that the higher between-hemispheric connectivity commonly found among females and a higher within-hemispheric connectivity among males (Ingalhalikar et al. 2014), partly explain gender differences on the aforementioned *people vs. objects* preference (Baron-Cohen et al. 2005). Evolutionary psychologists argue that factors such as male competition, tool construction and

Man the Hunter shaped brain development in a way that yielded these sex differences (Geary 2010). However, the suggested links between brain, hormones and evolution on one hand, and the underrepresentation of women in science on the other hand, are far from being precise, clear, robust, or consensual. Rather, some of the arguments are highly controversial. Some counter-arguments are, for example, that *Woman the Gatherer* also needed spatial skills for her activities, thus these should have had an evolutionary advantage in females as well (Newcombe 2007). Developmental psychologists conducting infant research find no evidence that either sex is born better equipped for learning in any domain (Spelke 2005). Many researchers acknowledge that there is no simple path from observed biological differences to learning and education. Yet, it is not uncommon to hear in public discussions and the media about a "male" and a "female" brain, or about innate differences that determine gendered preferences. Often, such statements are overgeneralized and oversimplified. In other contexts, speaking about biological sources of cognitive or social gender differences may be viewed very negatively, because it implies that some gender differences (especially if disadvantaging women) are innate and therefore immutable. However, here too there is a misconception, since biological is neither necessarily innate nor immutable (Miller & Halpern 2014, Newcombe 2007).

What about nurture? The extent of research and theory regarding social influences on gendered choices or performance differences is vast. In our course, we first briefly introduce students to the development of gender identity in childhood, as well as to non-conforming gender identities (e.g., transgenderism). We then dedicate more attention to studies on gender norms and stereotypes across development that are relevant to STEM. For example, although female scientists appear more often in children's drawings today compared to a few decades ago, early adolescent girls switch from drawing more female scientists to drawing more male scientists (Miller et al. 2018). Whereas preschool children perceive members of their own gender as similarly smart, starting from age 6, girls are less likely than boys to associate brilliance with their own gender (Bian et al. 2017). These early beliefs are associated with children's interests, and are perceived as precursors for later educational choices. Among adults, stereotypes regarding gender and science are prevalent as well, and have been respectively linked with interests and choices in STEM fields (Nosek et al. 2009). Relatedly, students' academic self-concept—the degree to which one feels competent in a specific academic domain—also shows gender differences and has implications for later educational and career choices (Marsh et al. 2019, Stout et al. 2011). A lower self-concept in mathematics is consistently found among girls, even when controlling for actual performance level. In this context, motivational theories such as the Expectancy Value Theory (see Eccles & Wigfield 2002) provide a comprehensive framework for understanding differential educational choices by gender. Of course, research on social influences is not without limitations either. For example, measuring stereotypes or assessing teacher's bias is highly challenging. Consequently, there is an ongoing debate around some findings' validity, generalizability and replicability.

Having introduced some core issues regarding gender and STEM, we now turn to describe the setup of our course in detail. Afterwards, we discuss how students experience the course, as well as our perspective as instructors.

A Course on Gender Issues and STEM

To incorporate the aforementioned perspectives and debate into a coherent course for students, we designed a two ECTS-points elective course entitled "Gender Issues in STEM and Education". Our group at ETH Zurich, headed by professor Elsbeth Stern, is responsible for teaching all students enrolled in the teaching diploma program. These are mostly advanced students (master's and doctoral level) who plan to become secondary school teachers in STEM subjects, either at the Gymnasium or Sekundarschule. Our course is usually given each

semester and enrolls up to 25 students. Occasionally, interested students not in the teaching diploma program join us as well.

The overarching learning goal of our course is to familiarize students with gender issues within STEM domains and with ongoing debate in this field. We also want students to develop critical thinking regarding existing perspectives, and to be able to integrate this critical thinking into their work as teachers. However, we also emphasize that we are not providing a "toolkit" for the classroom. Rather, we focus on conveying an appreciation of the width and complexity of this scientific topic, and supporting students in continually educating themselves throughout their career.

The course comprises 12 weekly sessions and two to three additional writing time sessions dedicated to the final assignment, which we explain below. After an introduction and an instructor-led session, eight of the total of 12 sessions are divided into 1) an instructional part, provided by us in the form of direct instruction, and 2) a student-led part consisting of two student presentations of mandated literature in each session, followed by a discussion. We divide the class into a (deliberately chosen) stereotypical *pink* and *blue* group. Each group reads one of two articles and a member of the group presents it in class. This division limits the workload for students by splitting the mandated literature between the groups. Students are asked to additionally read the abstract of the paper presented by the opposing group, or the entire paper if they wish to. We selected the articles based on the quality of the peer-reviewed journals in which they were published, the established record of their authors, or whether papers influenced the field of publication. The resulting literature provides mostly high-quality empirical research to students, but sometimes also emphasizes influential but methodologically criticized papers. Figure 1 shows the content of each session alongside with the selected articles that are read and presented by the blue and pink group respectively.

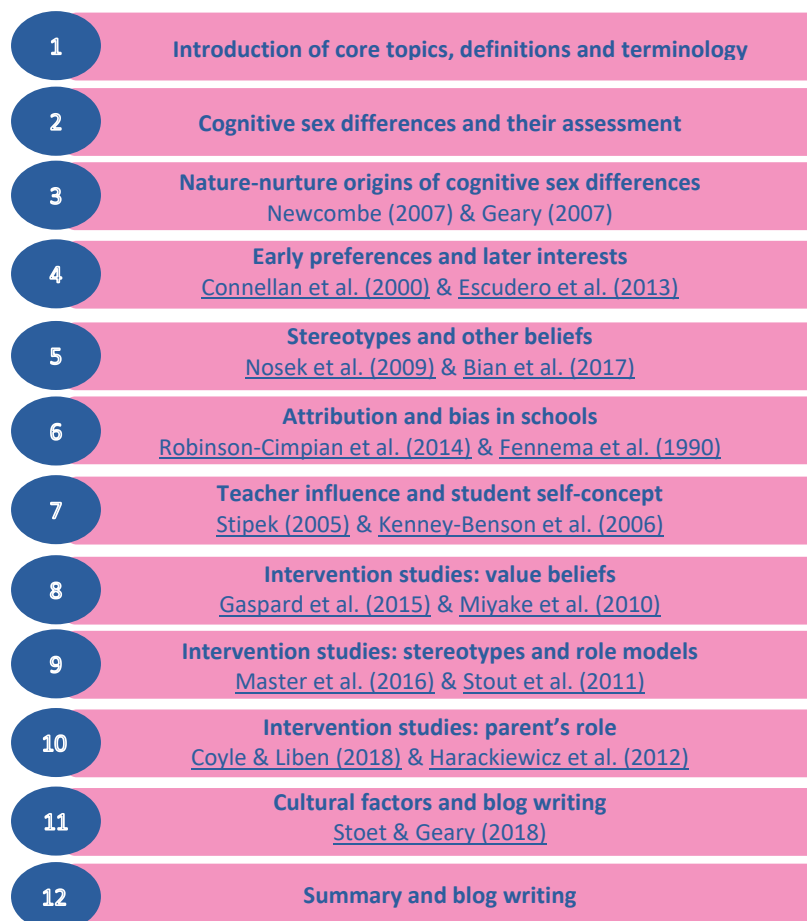|	
1	**Introduction of core topics, definitions and terminology**
2	**Cognitive sex differences and their assessment**
3	**Nature-nurture origins of cognitive sex differences** Newcombe (2007) & Geary (2007)
4	**Early preferences and later interests** Connellan et al. (2000) & Escudero et al. (2013)
5	**Stereotypes and other beliefs** Nosek et al. (2009) & Bian et al. (2017)
6	**Attribution and bias in schools** Robinson-Cimpian et al. (2014) & Fennema et al. (1990)
7	**Teacher influence and student self-concept** Stipek (2005) & Kenney-Benson et al. (2006)
8	**Intervention studies: value beliefs** Gaspard et al. (2015) & Miyake et al. (2010)
9	**Intervention studies: stereotypes and role models** Master et al. (2016) & Stout et al. (2011)
10	**Intervention studies: parent's role** Coyle & Liben (2018) & Harackiewicz et al. (2012)
11	**Cultural factors and blog writing** Stoet & Geary (2018)
12	**Summary and blog writing**

Figure 1: Topics and discussed research per session.[4]

Instruction-led part of each session

In this part of the session, we provide an overview of theory and empirical findings regarding the key topics displayed in Figure 1 and described in the introduction. We critically discuss study quality, present unanswered research questions and inform students on ongoing debate. We update and improve this part each semester, by including recent publications or expanding on criticism of existing studies. We also occasionally provide additional information outside of preplanned topics if students request this or as a result of a specific classroom discussion. This allows us to play into new developments, students' interests, and of course satisfy everyone's curiosity when needed.

In addition to reviewing key aspects of gender issues in STEM, we emphasize intervention studies focused specifically on means for reducing STEM gender gaps. Given that our target group are (future) teachers, we think it is very important to get some understanding of possible interventions, something also echoed by students themselves. However, we also want to make students aware as to what might be expected from interventions. The reality of gender and STEM is often complex, as many individual factors interact (Halpern 2014), meaning that there is no such thing as a "simple fix" for teachers. In addition, the immense increase of using positive words – words such as *innovative*, *novel*, or *groundbreaking* – in research papers over the last 40 years (Vinkers et al. 2015) makes it even more difficult to accurately judge the quality of an empirical study or to know which intervention is useful in a classroom. After all, if everything is groundbreaking, essentially nothing is.

So although this is not a methodological course, we do pay additional attention to the methodology and design of research we bring forward. As often the case in social sciences in general, studies differ considerably in sample size, appropriate statistical analysis, control of variables and overall design. With these differences between studies, the overall replication 'crisis' found in psychology (Open Science Collaboration 2012), and the complexity of human behavior under investigation, we consider it important to be aware of those methodological shortcomings. Doing so should prepare teachers for the intricacies of gender issues in STEM in both content and methodology.

Student presentations

In accordance with our course goals, we designed the student presentations as opportunities for students to learn about the perspectives debated in the field, as well as to bring their own critical view on empirical research. In some sessions, these perspectives are more complimentary, such as stereotypes and achievement on an international scale (e.g. Nosek et al. 2009) and recently discovered stereotypes, such as *field-specific ability beliefs* (e.g. Leslie et al. 2015). In other sessions, studies are chosen to help contrast and debate, such as when discussing sex differences in neonatal social perception (e.g. Connellan et al. 2000, Escudero et al. 2013). As we show in the student experience section below, students often struggle to see the relevance of studies with neonates for their classrooms. Yet, we find that discussing

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[4] The links lead to the journal's page with the article. Newcombe (2007) and Geary (2007) refer to book chapters (see reference list).

the contrasting views and results of these papers can be incredibly useful to understand the arguments brought up in discussions regarding innate sex preferences for *people* vs. *objects*.

The study by Connellan et al. (2000), for example, has proven very influential, being cited over 600 times since its publication. Their results were in line with the hypothesis of innate sex differences in preferences, with girls assumed to be innately attracted to people and boys to objects. These results could then be taken as indication that trying to motivate girls for STEM subjects could be of little value. However, as these results appeared hard to replicate, and more experimentally controlled studies found no such differences (e.g. Escudero et al. 2013), it provided us with a good opportunity to discuss methodology within this complex topic, and how this might influence the debate. The methodology implemented by Connellan et al. (2000), for instance, could not exclude experimenter effects (see Doyen et al. 2012). The overall small sample showed very little difference for the majority of the neonates investigated. Moreover, as mentioned in the introduction, biological differences are not immutable, even if sometimes presented as an all-encapsulating answer. Contrasting both papers effectively introduces the debate on innate or socially acquired differences that is the basis for a lot of empirical research. It also provides a good platform for students to discuss their ideas, practice critical thinking and get an understanding of how early interests of neonates might be relevant to their practice as teachers.

Blogpost assignment

As a final assignment, we require students to write a blogpost about two empirical intervention studies that have previously been discussed in class as student presentations (see Figure 1). Blogposts are a popular method of introducing and discussing specific topics in an approachable way. As such, we figured that writing a blogpost is a good way of giving students practice with relevant interventions, critical reading, and ways of communicating academic literature in an understandable way. This goal ties in with an overarching aim towards teachers being able to educate themselves and others, continuously throughout their career.
The blogposts are written in groups of two to four students. Figure 2 gives an impression of the blog with posts written by the students. We ask students to provide a first draft, followed by a peer-review phase in which each student reviews one to two other posts. We emphasize the use of positive and constructive feedback, and specifically highlight the importance of argumentation. Students who review a post and are suggesting changes should argue their reasons for these changes, whereas students who receive feedback should argue their reasons for not accepting these suggestions.

We ask students to describe both studies to a fictive audience of parents and colleagues at their school, in the form of a coherent story on two relevant interventions. This means that students should find a common theme, provide readers with the most important information from the studies, integrate findings and conclusions, and link the topic to their work as teachers. We provide students with two categorization schemes of interventions. The first is the scheme by Liben and Coyle (2014), which emphasizes goal types for reducing STEM gender gaps. The second theme is developed by us, and consists of categorizing interventions by their focus (i.e. student-focused, teacher-focused, or environment-focused) and their type (i.e. interventions on social and individual factors, interventions on learning and instruction, or comprehensive interventions). These schemes help students to organize intervention studies, often differing in methodology and target populations, around meaningful themes.
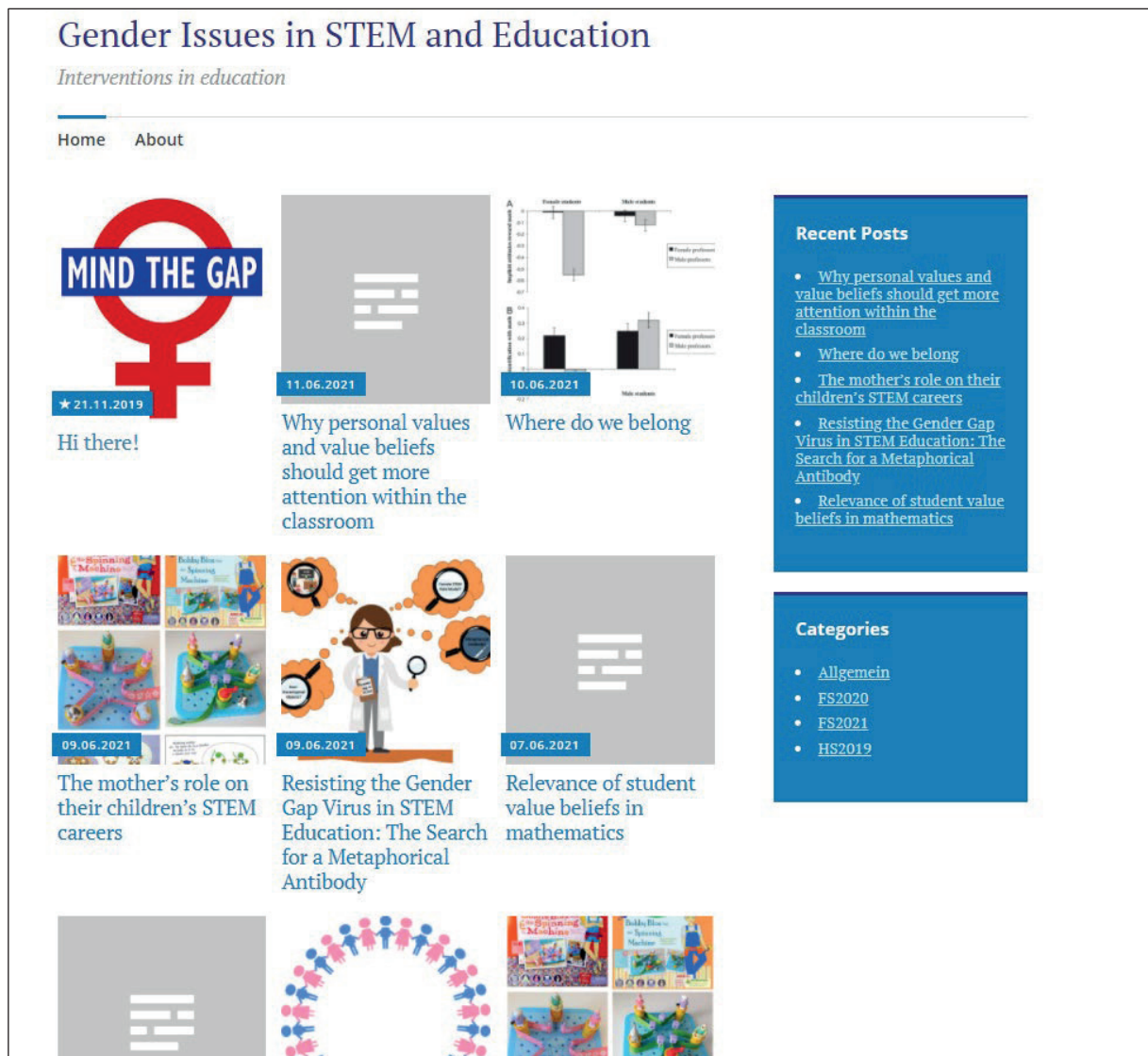
Figure 2: Homepage of the blog with posts written by the students.

Reflecting on the Course

Students' Responses

Towards the end of the semester, we ask students for feedback on the course. In general, students react very positively to our course. They also give constructive suggestions, which we implement in further iterations of the course. In spring semester 2021, we collected feedback from 19 students, in response to several open-answer questions. We extracted a few noteworthy answers and grouped them below into overarching themes.

Our students especially liked the format of the course, having presentations and discussions on research articles and the blogpost assignment. Some students mentioned that they would have liked further discussions on gender identities and non-binary gender, which we could only marginally discuss in the current setting.

Surprising insights

Many students mentioned that the topic turned out more complex than they initially assumed. On being asked what was new to them, one student answered:

"A lot! Especially that there are so many reasons for gender issues in STEM, and that it is very hard to connect everything and make causalities."

Many of the students had prior experience with debate and discussions about gender issues. Yet, they realized that the scientific approach to the topic and the intervention studies were new to them.

While discussing these studies, students also showed critical thinking, which was one of our course goals. For example, one student commented:

"It surprised me how many of the studies employ questionable statistics, and still get published in big journals. Of course, the gathered data is still valuable and I am still taking their findings seriously, but this reminded me not to trust any headline without looking into what was actually found in the science."

Importantly, students also became aware of the similarities between genders as shown by this comment:

"I take with me the input, that similarities are way stronger than the differences."

Students also remarked that they learned how important it is to reflect about the topic in general:

"I feel like it is very important to be conscious about those topics. I thought it might just be enough to assume everyone to be equal."

Changing perspectives

When asked whether they started thinking differently about some aspects, one student mentioned:

"It has definitely sharpened my awareness for gender differences. (…) I also reflect more on my own behavior and how to fight implicit stereotypes I might have, even outside of the gender dichotomy."

Students also mentioned having developed a more nuanced view on the matter. Regarding their experiences at ETH, while some praised ETH for doing a good job, others remarked that some stereotypes are deeply inclined:

"I think ETH does a good job in a lot of things. It's also hard to blame ETH for certain things as the reasons for certain situations might rather emerge during school."

"I realized how deep some stereotypes at ETH remain. Like how in different departments, it is a huge thing being a woman, and how peers and others react (sometimes negatively) to that."

Open questions

Questions that remained open to the students revolved mainly around the topic of actions:

"What can we do to change the pressures exerted on boys and girls by socialization? Yes, we can try to actively combat them in the classroom, but it seems to me that much of it is upbringing in the end. While we can offer information to parents, it is unclear how readily parents will do the work to confront their own gender stereotypes and want to give this on to their kids."

This statement showed a rather disenchanted view on the teacher's role. Students often wanted to know more about what they could do in their future classrooms. Although easy answers are hard to provide, in our course students familiarized with possible interventions that have been empirically tested. When writing the blogpost, students had a chance to analyze intervention studies in more detail and to gain some experience in explaining them to an audience of colleagues and parents.

Another topic that we only marginally discussed in the course was the underrepresentation of men in social fields. Students mentioned they would have found this topic interesting as well, in the sense of equal opportunities.

Finally, an interesting experience that one of our female students described was an awkward feeling towards attempts to 'support' female students as a minority group. For someone who has personally not experienced difficulties for being a female student, it felt out of place. This was a good opportunity to discuss variation in individuals' experiences, and to ask whether assuming that female students in a male-dominant environment are necessarily disadvantaged is justified.

Our experiences: Balancing a challenging issue

When we first designed the course, our aim was to provide a rich overview of gender and STEM issues by getting to know the research behind it. In hindsight, this proved to be a very ambitious aim, because finding a balance between the scope of important research topics and in-depth critical analyses of specific studies was not easy. On the one hand, we wanted to cover important aspects of the field, although there is a huge amount of research and there exists no unitary approach. On the other hand, we wanted to convey the complexity and peculiarity of empirical research with a close look, yet without inducing confusion. Therefore, we decided to let the students read and discuss a selection of articles in depth, while we as instructors provided further content on each topic. After iteratively adapting the form and content of the course, we achieved a good balance between broadness and depth.

One aspect we often reflect upon is our dichotomized use of 'gender'. Although we dedicate time in class to the perplexities of the terms 'gender', 'sex', and the prevalence of alternative gender identities, most of the time we do refer to two categories. On one hand, this aligns with the fact that most people identify themselves as either male or female, and with the fact that most research uses this dichotomy. However, we wonder whether this might induce, at least sometimes, stronger perceived gender differences than necessary. So far, we thought it was beyond the scope of our course content to elaborate on this issue, but we may dedicate more time to it in future iterations.

One question that remains open to us is how much impact our course has in the long run in terms of potential change. We are convinced that informing students about the current issues and sensitizing them to the complex topic designates an important step. Especially for teachers (either in schools or universities), who exert a large influence on their students, being knowledgeable about gender issues is important in understanding the network of intermingled causes. Overall, while preparing and giving this course was demanding, it turned out to be a great opportunity to increase future teachers' awareness and knowledge about this topic. By this extensive description, we have hopefully provided ideas and incitation for other higher education teachers.

Acknowledgments

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Reflections on diverse and inclusive teaching

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Abstract

In this paper we will describe our attempt to change a very traditional 2 semester course in Linear Algebra for maths and physics students with a high-stake exam into a more diverse and inclusive experience. We will first describe the background of this course both in light of the Swiss educational system and in the setting of the Maths and Physics Department at the ETH Zürich. In particular, we will address recurring, gender-specific patterns which are common to most STEM subjects taught at ETH. This will be followed by some thorough considerations on the macro and micro planning of the course. We will then describe both the structure of the courses and the changes that were made and how the actual teaching was done and changed and we will finish with a description of the exam. Finally, we will analyse both the exam results and reflect on some observations made over the course of the two years we taught this course.

Description of the course and background

In this paper we will describe two consecutive years of a standard one year linear algebra course for mathematics and physics students at the ETH Zürich. This course is a two semester course, each semester consisting of 14 weeks of 4 hours of lectures and 2 hours of exercise classes. For various reasons to be described below, we decided to make some smaller and some bigger changes to the course and we will reflect here on the reasons for these changes and their effects.

The Swiss educational system

Before diving into the details of the ETH, its curriculum and the general conditions, we first need to explain the nature of the students entering the ETH as first years. The Swiss educational system is determined very much by the federal structure of the country. Switzerland consists of 26 cantons and up to and including secondary education the canton is effectively responsible for the curriculum taught. Although there is a national curriculum, the cantons can decide how to interpret this. In particular neither the number of hours dedicated to a particular subject, nor the total years of schooling, nor the precise contents to be taught nor the way of examining is determined centrally. Nevertheless, Swiss politics demand that every student who achieved the Matura via finishing the so-called Gymnasium (around 23 % of the women and around 16 % of the men, however this varies hugely over the regions, see Wolter et al. 2018) is granted free entry (i.e. no entrance exams or required minimal grades) to any degree he or she decides to pursue at university (with the exception of human and veterinary medicine - for practical reasons). Besides this, it is possible for students to put a special focus, e.g. on maths and physics, during their final years in the Gymnasium but such

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a focus is never a required prerequisite for entering certain degrees. The result of all this is that there is as much as a factor two between the number of lessons in mathematics that students have had before they enter university. On top of that about a quarter of the students studying maths and physics at the ETH come from abroad (mainly Germany and Austria as teaching in the first year is done in German).

The result of the above mentioned system is that the population that starts a degree at the ETH is enormously diverse and it is not easy for first year lecturers to know where to start and what the right pace should be. How one can deal with this diversity is one of the topics of this paper; the considerations put forth should merely be understood as an attempt to tackle this problem with no claims for correctness or completeness.

The maths and physics department at the ETH and the degree structure

As mentioned before the ETH has no entry requirements besides the Matura for the Swiss students and therefore the exams at the end of the first year are often considered as such. Depending on the degree and the department up to 50 % of the first year students fail these exams at their first try or do not even show up. Therefore, these exams certainly qualify as high stake exams. Up until the summer of 2016 the examination always took place in one block in August which increased the pressure even further. It is important to note that the results for these exams were usually available to the students only a few weeks before the start of the new semester and therefore after the registration deadline in case the student wanted to pursue a different degree.

As in many institutions in Europe the number of female students in maths and physics is relatively low (varying between 20 % and 30 % of the first year population). It has been shown that the best means to predict performance for degrees in mathematics, natural sciences, and engineering sciences is obtained by combining the average grade in high school and the specific grade in mathematics (Trapmann et al. 2007). Nevertheless, an internal evaluation has shown that although women enter the ETH on average with slightly higher school grades (in mathematics) than their male peers, they fail the final exams at the end of the first year significantly more, see also Deiglmayr et al. (2019). This phenomenon is reminiscent of the findings in Rosser (1989), where it was found that high school GPA is only poorly correlated with SAT scores, although high school GPA is a good predictor of college GPA. As stated in Berkowitz et al. (in press), biological factors and differences in basic cognitive abilities may contribute to this phenomenon, but these cannot explain the substantial cross-cultural and historic variability in gender inequality in entry into STEM. Evidence discussed by Gayles & Ampaw (2014) suggests that women who study STEM subjects experience a "cool environment," are more likely to feel discriminated against, try harder, and seek help more often than men.

As a recurring theme to this article, Ballen et al. (2017) found that high stake exams systematically disadvantage women because of the stronger effect that test anxiety has on women's performance. The high dropout rate after the first year and the underperforming of the women together with other, for this article perhaps less relevant, factors, made the maths and physics department decide to restructure their program. To this end they introduced the so-called "Split Basis Prüfung" meaning that a first block of exams was planned for January / February and the second block in August consisted of the remaining courses. The goals were manifold: to reduce the pressure over the year (less of a high stake exam), to provide feedback to the students earlier in the academic year, and also to reduce the gap in exam performance between the genders, e.g. splitting up the first year exams into two batches should convert the single high stake exam (period) into batches of slightly lower stake exams, thereby reducing the negative impact of high stake examinations on the performance of women.

Planning of the course

Linear Algebra and Analysis are the two main maths courses in the first year for maths and physics students and are traditionally taught by a full professor of the maths department, which in particular implied that they were taught by men. Given the observed impacts of belonging uncertainty (Deiglmayr et al. 2019) the department decided that at least one of the two courses was to be taught by a woman and the first author was asked to lecture Linear Algebra in the academic years 2016 / 2017 and 2017 / 2018 to which she agreed. As she was on sabbatical the semester prior to this, there was plenty of time to prepare the course.

When planning a course like this, you first of all need a red thread. In Linear Algebra one of the crucial decisions to be made at the beginning is the following: Do we start with "vectors and matrices" or with "linear maps and vector spaces"? In engineering courses almost always the first approach is chosen, which absolutely makes sense for a population meeting this material for the very first time and exactly needing matrix computations. However, our population does not consist of future engineers. Vector geometry is part of every high school curriculum, but matrices are done (intensively) by some and are not even mentioned by others. In order to remove the advantage of prior knowledge here, we decided to start with linear maps and vector spaces so that the course was from that start new for all. Another advantage is that we immediately dived into abstract maths and thereby perhaps gave a better representation of the topic for people pursuing a maths or physics degree. In particular, if we started with matrices, then the first exam in January would necessarily mainly have been about matrices and matrix computations; this would not truly reflect the character of the degree, thereby perhaps selecting the wrong people, and it would mainly benefit the students that were lucky to practice these calculations during high school.

During the sabbatical at the UC Berkeley the first author attended a series of lectures on linear algebra by professor Edward Frenkel which served as an inspiration for the style of our lecture and also introduced the lecturer to the book "Linear Algebra" by Friedberg et al. (2003), which was thereafter chosen as the main course reference. This was different from the traditional German literature for this course, which was still on the reading list. The reason for this choice was that it first of all follows the approach mentioned above - starting with linear maps - and secondly its style. In contrast to the classical German literature (Jänich 2004, Fischer 2014), it is a lighter read and has a more colloquial tone of explaining. This does not mean that details are omitted or that the mathematics is not rigorous - on the contrary - but that the language is a little less compact and thereby perhaps a little more accessible for people who are taking an abstract maths course for the first time.

Organisation of the course

When organizing the course, we focused on the following three observations for which we wanted to improve the students' experience. First, we note that both the structure and format of the first year curriculum have developed historically. In particular, the two main mathematics courses, namely Linear Algebra and Analysis, are taught as classical lectures. Given the growth in population, mobility of students, and a continuous rise of the proportion of high school students obtaining a Matura, this results in a lecture for approximately 500 students. Add to this a reputation of the first year at ETH of being particularly difficult and the association of mathematics with brilliance (Deiglmayr et al. 2019), it is not very surprising to hear that many students do not perceive the classroom atmosphere as welcoming or inclusive. Second, to this day women are underrepresented among faculty at the math department of ETH. Such underrepresentation is often associated with higher levels of reported belonging uncertainty for the women entering such a degree (Deiglmayr et al. 2019). Third, the curriculum for the first year is very densely packed and so is each of the separate courses taught. Therefore, the connection between the separate courses is relatively difficult to spot so early in the career.

In order to emphasize the connection between the (in fact all) mathematical courses, the lecturers decided to teach the first two weeks of the semester jointly, i.e. instead of attending two distinct courses of four and six hours each per week, for the first two weeks of the semester the students were effectively taught (alternating by one or the other lecturer) one single course of ten hours per week, where the common foundations were introduced. After that, the course split up, each part focusing on a different set of tools and the associated type of questions; more algebraic in nature in Linear Algebra and more topological in Analysis. This initial collaboration also made it easier to coordinate other forms of coordination for the rest of the year, as will become apparent below.

Underrepresentation of women, although most pronounced at this level, is not only observed among faculty but already on the level of advanced students. The weekly exercise classes, held among groups of approximately 20 students and one teaching assistant, are usually organized by advanced students that passed the first two years of study with good to excellent grades. In the spirit of rewarding good performance, the teaching assistants were commonly picked according to the grades, which given the lower number of women passing the first year inadvertently resulted in exercise classes being almost exclusively led by male assistants. Of course, it is by no means necessary to have excellent degrees to lead a good exercise class and therefore, in an attempt to cope with belonging uncertainty, we chose the teaching assistants so that approximately half of them were female. There were enough advanced female students to ensure that the teaching assistants chosen still all had good to excellent grades.

Several measures were implemented in order to generate an inclusive and collaborative atmosphere. One measure was the organization of a dedicated Study Center, which was run jointly by the teaching assistants for the exercise classes in Analysis and in Linear Algebra. The Study Center was a place for the students to work on their exercise sheets, with the opportunity to ask the assistants for help. In the case of students asking questions, the assistants were supposed to pair the students with other groups of students working on the same problem and facing the same issues. This way, the students would communicate the inputs obtained among one another and ideally jointly work on the problems. In addition, both lecturers regularly showed up in the Study Center, again showing that they cared.

In a similar spirit, the exercise sheets in Linear Algebra contained marked exercises which were meant to be solved collectively in the exercise classes. The guiding principle for these exercises was that they should be of a more conceptual nature, requiring the students to precisely understand the abstract objects and properties discussed in the lectures. In particular, these exercises lent themselves to explication via examples and counterexamples. It was the duty of the teaching assistant to guide the discussion with the aim at deepening the understanding.

In order to encourage a collaborative and inclusive atmosphere in the exercise classes, we made an effort to provide a collaborative atmosphere among the teaching assistants as well as between them and the lecturer. In particular, there was a weekly meeting between the authors and the teaching assistants where the assistants reported on the difficulties the students were facing and the lecturer informed the teaching assistants about the upcoming material and the intended focus both in class and in the exercises. Moreover, we organized a sequence of peer-visits, i.e. the teaching assistants were visited in their exercise class by another teaching assistant. Besides the direct feedback, the assistants then discussed their observations in groups during the weekly meeting.

Finally, we need to mention that the students are allowed to take a summary of the course to the exam. It has been observed that often summaries consist of a collection of solutions to "typical" exam questions and essentially a transcript of most of the course in extremely small

font. This in turn necessitates more and more difficult exam questions and, in addition, has the undesirable effect that every year the questions in the exam have to be essentially new. Both of these make it harder to come up with reasonable exams, as very difficult exam questions in effect force everybody to fail except for a few particularly talented students. In reality, instead of extreme rates of failure one will observe that the necessary score for a passing grade will be extremely low. In order to reduce this impact of the summary and in order to provide a means of participation, we set up an online summary - in the following called eSkript after the platform used - of the whole course and towards the end of the semester offered the students the possibility to vote on what items of the eSkript should be included in the summary, which was then handed out with the exam.

Teaching of the course

When teaching a new course, one always has to put special emphasis on the preparation of the very first lecture. In this lecture, the tone for the remaining lectures - in this case for a full year - will be set, and the expectations and attitude will be communicated to the crowd. Our main goal for the first lecture(s) was to make the students feel safe and fine. This new environment for them should be one characterised by mutual respect, a safe learning environment for all. In order to achieve this, we started with a very brief but personal introduction of ourselves, showing that we are more than a "proving machine" and human beings too. We also emphasized from the beginning that all questions are welcome and that no such thing as a stupid question exists. And then we really tried to live up to this (which is much harder than only stating it in the beginning).

A tool that we have learned to value quite a lot is the so-called EduApp, a Clicker tool developed by the ETH, which can be used on computers and mobile phones. Over the years evaluations have shown that students very much appreciate the use of this app in class. A common application of the EduApp is in the form of a single choice question asked via the app (in this case called a "clicker question"). The app then collects and displays the distribution of the students' answers. One reason for the popularity of this is certainly that the tool is anonymous and that it not only allows to see the correct answer but also to see that, even if they answered the question wrongly, the students are usually among several students that made the same choice, therefore possibly strengthening a sensation of belonging even in case one could not answer the question correctly. This is in stark contrast to the case where one of the (usually exceptionally strong) students provides the (usually correct) answer after a frighteningly short period of time. We made an attempt to ask one or two clicker questions in every lecture. Such questions could either quickly check whether a definition was well understood, or have the students do a small calculation etc.

Usually this took no more than 3 minutes, sometimes giving time for short peer-to-peer discussion. These Clicker questions first of all give the students a short break - concentrating for 90 minutes is very hard - and also function as a short self assessment. The students see whether they understood the last concepts and also how well they did compared to their peers. At the same time, it gives the lecturer direct feedback on how well his / her teaching has been understood and finally, and this is a very important detail, it shows the students that the lecturer cares about their learning process. We believe that this last effect is much underestimated and deserves to be emphasised. Students are much more willing to work for a course, if they sense that their progress is of importance to the lecturer. Therefore, one should use every opportunity available to show that one genuinely cares.

In what follows we provide an example of such a question. After having introduced the concept of eigenvalues and eigenvectors, the question is whether the following statement is true or false "If a real matrix has one eigenvector, then it has infinitely many eigenvectors".
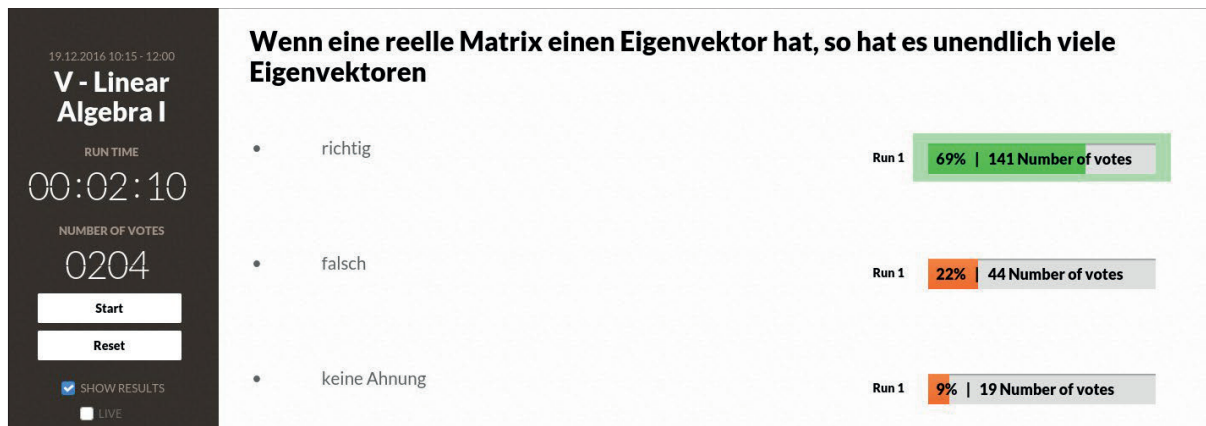
Figure 1: Screenshot from the EduApp Classroom Assessment Tool.

Note that we gave the students slightly more than 2 minutes for this question, as it needs no computation whatsoever. The last option "I don't know" is always there and it is encouraged that students do not guess but choose this option instead. This gives both the lecturer and the students a much more realistic picture about the understanding within the population and, indeed, this option is chosen quite frequently by the students. The question hints at the difference between eigenvalues (usually a finite set) and the concept of an eigenvector and the associated eigenspaces which show up right after this. As can be seen, almost 70% of the students were able to answer the question correctly already, whereas around 30% were still struggling with the concept. And even of the 70% that got the question right, it may have been the question itself that made them realise the validity of the statement. Clicker questions play a very different role than e.g. exam questions. The purposes are manifold and include feedback, deepening understanding, falling in common traps, the feeling of inclusion etc.

For most students a course in linear algebra is the first encounter with abstract mathematics. Therefore, it is of crucial importance that this encounter is smooth. Abstract maths can be scary and one needs to think very carefully about the right approach. We consider it advisable to be gentle in the beginning in order to keep up motivation - there will still be plenty of opportunity for frustration - but not at the cost of rigor so that eventually the students are able to start producing some mathematics, i.e. derive statements and their proofs, on their own. In order to be able to prove a statement, proper understanding is central. Linear algebra is very suitable for this start because a lot of geometric knowledge and intuition can be used in this process. As the lecturer is herself a geometer, she often used the "geometric picture" for clarification. In many cases, after proper clarification, the proof becomes merely a formality. Let us give an example. During the course the following lemma about cosets needed to be proved:

Lemma: *Let V be a vector space and let W a subspace of V. Then v+W is a subspace if and only if v is an element of W.*
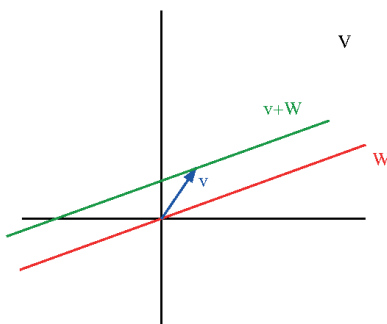
Now this in itself is a rather abstract statement. If one, however, considers the picture, then not only the statement seems obvious, but also the proof quickly becomes clear. That's why we started with the following picture (before even stating the lemma) and from there the students actually could guess the statement and the proof became a technical detail. This way we think students will not only understand the statement of this particular lemma in depth but also start to develop some tools for proving. By proving we do not mean prove what one is asked to prove, but to think for oneself about what could be true and then see whether one can prove it. This lemma illustrates this principle well and teaches "doing maths".

And finally, and this may sound completely trivial, we gave a lot of thought to how we wanted to explain things. Of course, as a lecturer one understands the material of the course and one is able to provide a rigorous presentation of the material. But one has to consider how to present and, more to the point, explain it to a novice to the subject. This actually takes up enormous amounts of time and from the student evaluations we learned that this part of the teaching was highly valued (and presumably is not standard). One has to be aware that writing down a series of logically correct steps may be an acceptable proof, but it does not explain the heart of the matter. The following example illustrates this: Matrix multiplication. In traditional engineering courses students are simply told how to multiply matrices and then they do this and they don't question it any more. That's not what we want from maths students. After all, there is a reason why matrix multiplication is done in a specific way. We chose to introduce linear maps first and from the representation of linear maps by matrices and their composition, the definition of matrix multiplication becomes natural.

Exam

The exams consisted of two parts, a single choice part which accounted for 25% of the total of points obtainable and open questions which accounted for the remaining 75% of the total of points obtainable.

Each single choice question consisted of a statement and the student had to indicate whether the statement was true or false. These questions were purposefully kept very simple to the extent that to any mathematician the answers to the questions should be obvious. The total achievable by single choice only was however so small that it was very difficult to obtain a good grade if the student had to actually spend time on these questions. Such a block of single choice questions serves as a light entry into the exam and we think this is a good method to do simple knowledge probing. Moreover, our data shows that the number of points obtained in the single choice part of the exam is very highly correlated with the total number of points obtained for the remaining questions, i.e. excluding the single choice part, therefore supporting the hypothesis that they test a similar set of skills as do the more classical open questions.

A common alternative to the simple single choice questions is a smaller set of more difficult single (or possibly multiple) choice questions offering more points. In case of multiple choice questions, it is customary to award correct answers with a point and subtract a point for wrong answers, as otherwise the only reasonable strategy is to mark every answer on offer. This introduces an element of risk to the examination, which in turn induces elicitation of behavioral patterns. Besides the fact that the goal of the exam is to assess the students' knowledge of the topic instead of behavioral patterns, the introduction of risk in combination with gender-specific risk-assessment might even systematically put one gender at a disadvantage (Schubert et al. 1999, Fehr-Duda 2006, Schubert 2006, Marin & Rosa-Garcia 2012, Baldiga 2014). Therefore, the decision for single choice over multiple choice. Our decision to choose a large set of simple questions was made in light of the findings that high stake exams tend to systematically "disadvantage women because of the stronger effect that test anxiety has on women's performance" (Ballen et al. 2017).

The remaining part of the exam consisted of open questions, which were organized in accordance with the material of the course, i.e. six (respectively five in the second iteration) questions each covering one of the main subjects of the course; the total number of questions in the second iteration was reduced because we noticed that in the first year the exam was perceived to be much too long. Every open question was split into three to four smaller parts of increasing difficulty to provide the students with a relatively comfortable entry to the topic and a means to warm up. Moreover, partial points were awarded and there was always the possibility to solve a later part of a question even if one was unable to solve the earlier parts.

Analysis of the exam performance

As a result of having taught the course over a total of two semesters, we had data for four examinations available. In particular, we have observations of individual performance not only on the level of the exam, i.e. individual grade, but on the level of exercises within the exam. We could not observe any qualitative effect of the above changes on the performance of women on average. The patterns are in line with the previous observations on the aggregated level, cf. the results reported in (Rütsche et al. 2019). On average, both on the level of the exams and (in most cases) on the level of individual exercises, the female participants were not performing better than the male participants. This is independent of whether the exercises were of single choice type, i.e. closer to knowledge probing, or open questions. Nor could we identify from this data any gender-specific factors that could influence overall performance, e.g. specific strategies to solving the exam. In the end, even though the students explicitly appreciated the atmosphere in the course as well as many of the measures introduced, the data on relative performance is very much in line with the data for the whole year and similarly with the results from previous years.

Conclusion and further reflections

As described throughout the article, we introduced several measures simultaneously and therefore it is not possible to judge the effectiveness of each measure on its own. Overall, we conclude that the combination of these measures does not affect the discrepancy in failure rates in a significant way. In particular, we conclude that the gender gap has to be addressed separately and might require much more substantial examination besides a few tweaks in the classroom.

In view of the evaluation of the course, we still recommend most of the measures introduced for the course, not with an intent of influencing the performance gender gap but rather with the aim of generating an inclusive classroom atmosphere. The collective generation of a summary was not appreciated among the students and there is doubt that this was truly perceived as a collaboration among students and the organizers of the course. In view of the resource intensity of this measure, it seems advisable to look for a different way to attack the problem with the individual summaries. With respect to the other measures, the students explicitly mentioned the welcoming atmosphere, the use of the clicker-questions, and the apparent interest of the lecturer as motivating factors for the course.

Acknowledgements

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I am different not less - Inclusion and diversity in the medical curriculum at ETH

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Abstract

Every disease is more than the sum of its symptoms and affects all parts of a personality. In reverse all parts of a personality will affect the disease. Therefore, the integration of inclusion and diversity into the medical curriculum is crucial for future medical doctors. Therefore, the foundation for inclusion and diversity in future patient care is introduced.

In this paper, we analyzed our medical curriculum of the bachelor in human medicine with respect to diversity and inclusion. The whole medical curriculum at ETH Zurich is mapped against the Swiss Catalogue of Learning Objectives for Undergraduate Medical Training (PROFILES) using the mapping software LOOOP. We identified learning objectives about diversity and inclusion in the medical curriculum based on the frequency of relevant profile items in the curricular map. The results show that different aspects of diversity and inclusion are covered across the whole curriculum namely in 11 different modules (out of 58). There are modules that concern practical skills (anamnesis), different organ systems (cardiovascular system, pediatrics) or scientific knowledge (translational animal models) as well as aspects of the general role of a physician.

Mapping of the curriculum enabled the longitudinal assessment of all relevant learning events. Although diversity and inclusion topics are already incorporated in the curriculum there is still room for improvement. For example, there is no coverage of transgender related medicine in our bachelor (e.g., hormone therapy) so far. Therefore, further work is needed to include additional aspects of diversity and inclusion in our curriculum.

Diversity in medicine

"I am different not less." This phrase from Temple Grandin in the context of autism describes the whole base for individualized diagnostics and treatment. Since the beginning of medicine, it has been clear that we treat humans not symptoms. Every disease is more than the sum of symptoms and disabilities. It may affect all parts of a personality and all parts of a personality will affect the disease. Therefore, medical doctors should consider them all when diagnosing and treating patients.

However, in the past, medical doctors were not enough sensitized for certain aspects of diversity as a variety of examples demonstrate. The effect of gender on disease outcome, e.g., in cardiovascular diseases, the underrepresentation of minorities in drug development trials, and the lack of technologies that specifically target female health care issues (Femtech), all these examples indicate that there is more work to do to anchor aspects of diversity and inclusion in medical education (Corsino & Fuller 2021).

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Inclusion into the new learning catalogue

The raising of awareness about diversity and inclusion in the medical community resulted in several new learning objectives in the new Swiss Catalogue of Learning Objectives for Undergraduate Medical Training (SCLO). The catalogue includes a common set of learning objectives, which students of all faculties should master by the end of their medical curriculum. In addition, the document defines the contents of the Federal Licensing Examination (FLE) according to the Federal Act on the University Medical Professions (MedBG/LPMéd); it is also a prerequisite for the accreditation of the curricula of the Swiss faculties of medicine (Michaud et al. 2016). The new learning catalogue PROFILES encompasses the common medical situations that a physician should be able to handle on the first day of his or her residency. It is divided into three chapters:

1. A first chapter is listing a series of learning objectives related to the different roles of doctors (general objectives, GO), inspired by the CanMEDs roles used worldwide.
2. A second chapter presents a set of entrustable professional activities (EPAs) reflecting the main medical tasks that a physician must be able to perform autonomously on the first day of his or her residency.
3. A third chapter lists 265 common clinical situations (situations as starting points, SSPs) that a doctor is expected to deal with after passing the Swiss Federal Licensing Examination.

Aspects of diversity and inclusion are part of all three chapters and are listed hereafter (see Table 1).

PROFILES on diversity and inclusion
GO 1.17. develop a critical awareness toward common stereotypes likely to bias clinical activities, related to, among others, age, gender, ethnical and cultural representations.
GO 1.18: identify the impact on health of sex (i.e., biological difference related to sexual determination), and gender (cultural and social differences between men and women in terms of roles and expectations). Address these issues in medical activities
GO 1.24: take into account the economic, social and cultural aspects of health maintenance prevention and care, at the individual and community level
GO 2.04: deal effectively with diverse groups of patients, such as children, adolescents, senior patients, men, women, and people with other gender identities (e.g., transgender); and patients with different cultural backgrounds and language
GO 4.04. identify and address the special needs of vulnerable populations, showing awareness of the importance of equity in the delivery of care. They seek collaboration with social services if appropriate
GO 7.04: show awareness of cultural, societal, and spiritual/religious issues that impact on the health and delivery of care of individuals and of the community
EPA 1.06: Assess gender, social, cultural, and other factors that may influence the patient's perception and description of symptoms; demonstrate cultural awareness and humility, and be conscious of the potential for bias in interactions with the patient
EPA 7.04. Take into account the patient's specific profile and situation such as gender, age, culture, religion, beliefs and health literacy; take into account the vulnerability of specific groups such as migrants, patient from low socio-economic level, adolescents
SSP 254: patient with other cultural background, migration

Table 1: PROFILES concerning inclusion of diversity into the medical curriculum in Switzerland.

Inclusion in the medical curriculum at ETH

In 2017 ETH Zurich adopted the curriculum mapping tool LOOOP (Learning Opportunities, Objectives and Outcomes Platform) that was designed to comprehensibly structure a medical

curriculum (Goldhahn et al. 2018). LOOOP was developed at Charité Berlin and ensures the alignment of all parts of a curriculum map including competencies, objectives, teaching and assessment methods (Balzer et al. 2016).

We were able to identify, where the profile items on inclusion and diversity are covered in our curriculum due to our curriculum map in LOOOP. The respective profile items are incorporated across the whole curriculum in 11 out of 58 different modules (see Table 2), starting in the first semester (e.g., EPA 1.06 in anamnesis technique) and concluding with the sixth semester (e.g., EPA 1.06 in psychosomatic and psychosocial medicine). Modules like ethics, law and communication are prominent to appear when talking about inclusion. Important basic knowledge in the areas of ethics, forensic medicine and communication theories are taught in this module. This way, students learn that patients do not only have to be assessed on a symptom level, but are always embedded in a social, legal, cultural, and family structure. As a result, the complete personality should be factored into shared decision-making in diagnostics and treatment. Students should learn how to transfer theory into practice via skills straining on communication. Empathic communication at an eye-to-eye level is curial for a successful patient interview.

A different module, which shows how important inclusion and diversity are, is "interprofessional pathways". The students learn how an ideal patient pathway should look like but also how through the lack of inclusion and diversity this is often does not happen. A successful patient pathway also depends on constructive interprofessional teamwork. Here the same aspects are key for successful interprofessional collaboration. In addition to ethical issues and inclusion of different cultures, anatomical and physiological sex differences are addressed in the different organ system modules. Very important are practical courses (anamnesis technique and from symptoms to diagnosis) where students are prepared for the contact with diverse symptoms. Furthermore, scientific basics (translational animal models) are relevant in order to design drug trials so that divers trial groups are included (e.g., women) to account for different reactions due to sex. In total 105 learning objectives are mapped against profile items listed in Table 1.

PROFILES	Mapped in the following semester and modules
GO 1.17	5th semester: geriatrics, ethics, law, and communication, interprofessional patient pathways
GO 1.18	2nd semester: cardiovascular system, respiratory system 4th semester: from symptom to diagnosis 6th semester: translational animal models
GO 1.24	4th semester: sensory organs 5th semester: pediatrics, ethics, law and communication
GO 2.04:	5th semester: ethics, law, and communication, pediatrics
GO 4.04:	5th semester: ethics, law, and communication
GO 7.04	5th semester: ethics, law, and communication
EPA 1.06	1st semester: anamnesis technique 5th semester: ethics, law, and communication, interprofessional patient pathways 6th semester: psychosomatic and psychosocial medicine
EPA 7.04:	4th semester: sensory organs, from symptom to diagnosis 5th semester: ethics, law and communication, pediatrics
SSP 254	5th semester: ethics, law and communication

Table 2: Inclusion of PROFILES across the medical curriculum at ETH Zurich.
Exported from the curriculum mapping tool LOOOP (extracted on 10.06.2021).

To provide a specific example: We extracted one learning objective of the module ethics, law, and communication of the fifth semester including profiles items. All mapped profiles items are in this case relevant concerning diversity and inclusion. Of course, this is not always the case and other profiles can be listed if suitable.
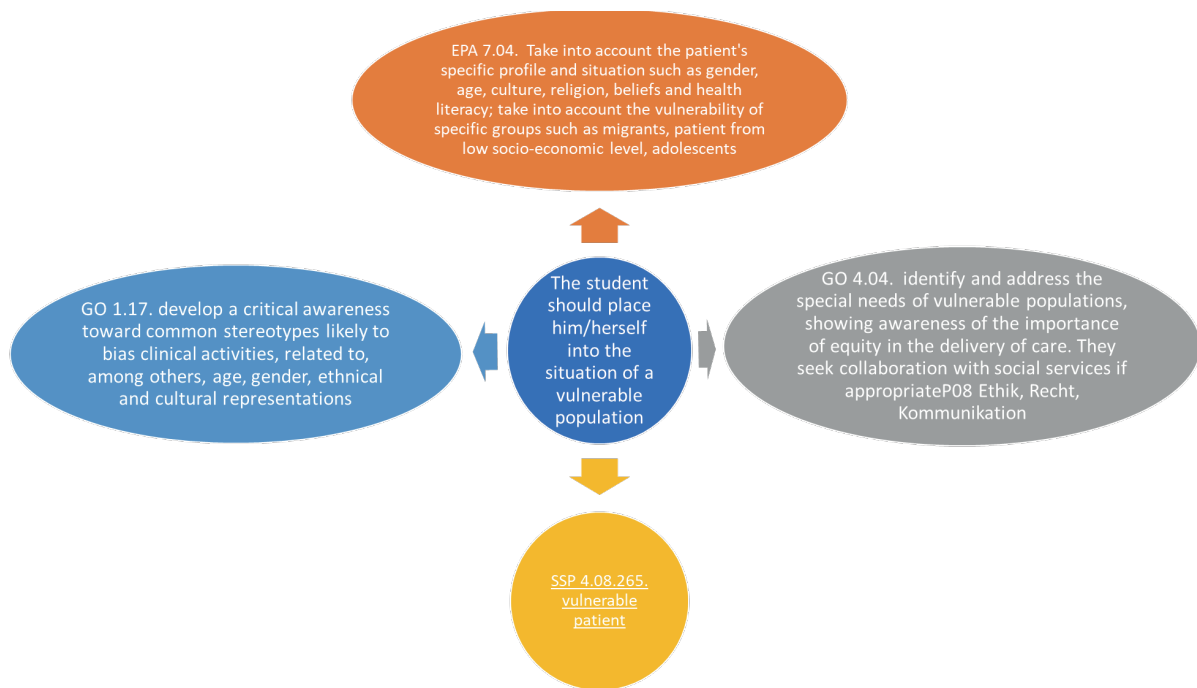
Fig. 1: Example of specific learning objective in the module ethics, law and communication of the fifth semester with the mapped PROFILES in HS2020 (extracted on 15.7.21).

Towards more inclusion and diversity

The incorporation of inclusion and diversity in a medical curriculum is a necessity that has a profound effect on the human health. We know about the gender inequality in clinical trials; but it is slow to change the processes involved. Considerations of the personality and the social circumstances of a patient are of utmost importance to find the right differential diagnosis, maintain high adherence or to provide adequate palliative care. Additionally, there are specific problems like the lack of access to medical care for transgender people (Safer et al. (2016)).

Gender identity is being discussed more openly and frequently nowadays but is still poorly incorporated in medical curricula (Safer et al., 2016). This is especially disturbing when looking at the evidence: studies have shown that transgender persons have a substantially higher risk of clinical depression, anxiety disorders and suicide attempts compared to their cisgender control (people where the gender identity matches the sex assigned at birth) (Safer et al., 2016 & Reisner et al., 2015). Additionally, Safer et al. (2016) point out that transgender patients report that the lack of physicians with expertise in transgender medicine is the main reason inhibiting access to medical care. This problem can be counteracted as a study by Safer & Pearce (2013) has shown: a simple curriculum content change increased the comfort of medical students with transgender medicine significantly. This topic gives a good example on how already minor changes in the medical curriculum can have a great effect.

This shows that possible improvements in the area of inclusion and diversity are still pending in many institutions, but the team at ETH Zurich is moving into the right direction.

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Reflections on the success of "The New Normal" webinar – facilitating community building and participant engagement

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Abstract

The COVID-19 pandemic will almost certainly prove to be a turning point in how people work and how they balance work and home life, the hope is for the better. However, early in 2020 there were reports of the disproportionate burden imposed on working women in Switzerland because of lockdown measures. The aim of the webinar series "The New Normal", organised by the Swiss Society for Female Engineers (SVIN) and the National Centre of Competence in Research (NCCR) Digital Fabrication, was to provide women working in practice or academia in the architecture, engineering, and construction (AEC) sectors with relevant information and concrete ideas about the nature of the new normal and its assumed or real effects on women. The organisers aimed to empower women to use the global upheaval to effect positive change towards a better, more gender-equal work-life. The webinar was also intended to give participants an occasion to connect and share their experiences of the "new normal". To achieve this dual objective, both content and format were given much consideration in the organisation of the webinar. This was clearly perceived and highly appreciated by participants as indicated in the final feedback poll in the last webinar session. In this article, we will describe our methods of combining content (i.e., research on and personal experiences of various aspects of the "new normal") and format (i.e., a setting engendering lively, meaningful, and open interaction) in the best possible way. The webinar was considered a success firstly because of the level of community building and exchange that was fostered between participants, as evidenced by recurring active participation, networking, and openness to share personal challenges and triumphs in the "Tales from the Home Office" session, and secondly, the quality of information and recommendations as documented in the final report.

Introduction

In early 2020 everything shifted online, and suddenly it seemed everyone was at the same time isolated but nonetheless more connected digitally than ever before. There were also concerns over how families could cope with lockdown, with stories and rumours about women reducing their work time to pick up the slack at home, the time of crisis causing a reversion to

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classic breadwinner family models. The fear was that women would lose much of the quick progress made towards equality for women in the Swiss workplace.

The architecture, engineering, and construction (AEC) sectors have a longstanding underrepresentation of women. Several associations and institutions are working toward increasing the number of women in these sectors and supporting them in their careers. The Swiss Society of Female Engineers (SVIN) is a nationwide association that brings together women in scientific and technical professions. The SVIN was founded in 1991 and is based in Zurich. The SVIN women's goal is to advocate for the concerns of the engineering profession and to motivate young women to pursue engineering and STEM professions (mathematics, information technology, natural sciences and technology). The National Centre of Competence in Research (NCCR) Digital Fabrication is a funding scheme of the Swiss National Science Foundation (SNSF) that develops digital fabrication technologies for use in construction and building processes. Regular partnered actions between SVIN and the NCCR Digital Fabrication include events with presentations on equality topics, role models, and networking opportunities for women in the AEC.

Building on their established partnership and mutual concern for women's careers in the AEC, the SVIN and the NCCR Digital Fabrication decided to develop a webinar identifying contemporary problems and solutions for AEC women in the "new normal". Ultimately, the aim was to help women to navigate or even steer the change in a positive direction for gender equality. The webinar was intended to provide empowering information on i) the current status quo of family structures in Switzerland and the historical context, ii) state-of-the-art research into the effects of the pandemic for employees in both the private sector as well as in the academic context, and iii) best practices for individuals and employers to maintain, or better, advance gender-equality in the current crisis.

In addition, the organizers wanted to provide a platform for exchange, support, and networking. By sharing their own stories or hearing from others, participants could view their individual situations from different perspectives, evaluate their options and act on their own behalf. Participants should also benefit from an inclusive and open environment where they feel recognized, valued, and encouraged to act. Finally, adding an element of networking was intended to boost participant's confidence, expand their current opportunities, and build a community of support.

Methods / Webinar design

Format

At the time of planning the webinar Switzerland was in its first lockdown and therefore all meetings, seminars and events were shifted online. It was not certain whether there would be a return to the office by the time the webinar should take place, October - December 2020, so the webinar was divided into 5 weekly online sessions, two hours each. The sessions were scheduled from 10-12:00 on Wednesdays, so that participants could plan to join with regularity. Each session was divided into two major parts, a "speed networking" event (see box: Speed networking) and presentations from invited speakers including discussion. Each session included a short break, usually after half of the time or after the first presentation if we had two speakers. We were aware that the internal diversity of each of the webinar's sessions posed a challenge in that attendees could easily choose to drop out during breaks, which is generally more likely with online events. In contrast to face-to-face meetings, participants feel less motivation to engage cognitively and behaviorally in remote meetings (Kuzminykh & Rintel 2020b). In order to bind together the different parts of each session and keep the attendees curious, invested and motivated to return after the break, we introduced polls as an additional program feature.

BOX 1: Speed networking
One practice known to increase meeting effectiveness is encouraging everyone to participate (Mroz et al. 2018). The speed networking activity was designed to get participants to engage each other one-on-one, to break the ice and have the opportunity to connect personally or professionally with other participants. The activity took advantage of the functionality of Zoom breakout rooms by providing a prompt as an icebreaker, then randomly pairing participants for a short period of time (3-4 minutes) to introduce themselves and answer the prompt. Participants were then brought back to the main room, given the next prompt, and then again randomly paired in breakout rooms. In total the activity lasted around 15 – 20 minutes, with a total of 3 or 4 pairings. This format was limited by the random pairing function of Zoom, which would occasionally re-pair participants who were paired previously. Additional time and effort were required if individuals indicated they wished to not participate in the activity, however in our experience most participants joined in.

At the beginning, middle and end of each session the Zoom "poll" function was used to ask questions that help set the tone of the different parts of the program. For example, the opening poll and the break poll (between the networking and presentation parts or between two presentations) would ask a personal question about participants' experiences during the pandemic with humorous answer choices (How would you describe your home office? Chaotic, covered in cats… What is your preferred handshake replacement? Fist bump, foot tap…). The break poll had the additional function of motivating participants to return after the break, so the question was posed at the start of the break and the results only revealed once participants had returned. The wrap-up poll included logistical questions about participants' intention of participating in subsequent sessions and feedback questions.

Finally, depending on the speaker preferences participants could directly ask questions during the presentations or use the Zoom "chat" function. Participants were free to comment or ask questions in German in the chat, which would then be translated by one of the organizers into English. This lowered the language barrier of the event.

Content

The organizers intended that the program content form a story arch of historic context - recent impacts - current actions - prospective future - synthesis - next steps (see box: Program overview). Speakers were sent "speaker guidelines" to clarify deadlines for biography, title and abstract submissions to the organizers, as well as to clarify roles and responsibilities of the speakers and the organizers. They were also warmly invited to participate in the speed networking activity with participants.

While the basic structure described above was the same in most sessions, two of the sessions stood out from the others: the first session and the fifth session. With the intention of allowing participants to warm up before the first iteration of speed networking, the first session began with the keynote presentation followed by a speed networking trial. Afterwards, participants were invited to give feedback on their experience and the activity format (Was there sufficient time given for introductions? Were the prompts appropriate and engaging?). The organizers adjusted the activity based on the feedback and the remaining webinar sessions began with the speed networking activity, followed by the presentations. This webinar architecture with differently structured sessions enabled participants to ease into a new networking activity, and allowed those who did not want to participate in the speed networking activity in subsequent sessions to easily join solely for the presentation.

BOX 2: Program Overview

- Keynote session
    - Dr. Christina Seyler (UZH) "Reconciling career and family in Switzerland: What do STEM women experience?"
- Research into "New" Work Processes
    - Prof. Dr. Gudela Grote (ETHZ), "No new normal in sight: Opportunities for experimenting with new work practice"
    - Dr. Patricia Widmer (HSG), "Corona: different effects on men and women"
- Corporate Policy Changes? The Employer's Perspective
    - Prof. Dr. Heike Bruch (HSG), "Leading in the New Normal – Dos & Don'ts for a real new work transition"
    - Dr. Nora Keller (HSG), "Covid-19 Policy Changes: Unintended Adverse Consequences for Women?"
- Tales From the Home Office
    - Participants sharing struggles, successes, surprises, funny anecdotes, bizarre moments, surreal experiences, and lessons for the future.
- New Work Culture?!? – Wish vs. Reality
    - Prof. Dr. Alexandra Cloots (OST), Presentation of survey from Projekt Neue Arbeitskultur des HR-Panels New Work
- Panel Discussion, "Lessons Learned: Making Lemonade in a Lockdown"
    - Moderator: Prof. Dr. Sarah Springman (ETHZ)
    - Panellists: Christina Seyler, Gudela Grote, Patricia Widmer, Nora Keller, Alexandra Cloots

The fourth session comprised the Tales from the Home Office, which invited written submissions of up to 500 words from participants to "share struggles, successes, surprises, funny anecdotes, bizarre moments, surreal experiences and lessons for the future". Participants could read aloud their own stories or have one of the organizers read for them, either anonymously or with credits. This session was intended to bring the real-life circumstances, challenges and achievements into the webinar and to demonstrate the breadth of experiences during the pandemic.

Results / Outcomes, Report

The webinar had 91 registrants in total, with a range of approximately 15 - 40 participants per session and 5-10 "regular" participants attending every session. Registrants were not only employed in AEC sectors or academia, but were from other sectors and even located abroad. There were a mix of women with families and without, and most were early in their careers. Participant numbers were steady through the first five sessions and increased significantly for the final panel discussion. Participants were engaged and active throughout, responding to poll questions, asking questions to the speakers and sharing personal anecdotes and insights. The organizers noted the environment was markedly light, energetic and enthusiastic throughout.

The content of the sessions was partly the result of the original intention of the organizers in designing the webinar (Research into "New" Work Processes: perspectives from academia and industry), and partly the result of the organizer's growing awareness of the topic, including

the invitation to Prof. Dr. Alexandra Cloots to present the results of their recent survey from the Projekt Neue Arbeitskultur des HR-Panels New Work.

The Tales from the Home Office session stood out from the other sessions for its intimacy, moments of intensity and feeling of connectedness. There were 13 submitted Tales, approximately half of which were read by the authors in the session. Participants showed astonishing candor, empathy and insightfulness in listening and sharing Tales. Several Tales described significant challenges faced during lockdown, including the loneliness, boredom and uncertainty of home office, the experience of having COVID-19, fleeing persecution over closed borders, navigating new online territories for work, balancing work and family when childcare centers closed, reflecting on coping mechanisms, adjusting to change and navigating life during a pandemic. Many stories were also positive: funny anecdotes of Zoom blunders, increased feeling of connectedness across distances, small joyful moments, improvised celebrations and the freedom and flexibility of home office. Several participants followed up with one another after this session, asking about improvements or successes, and offering advice and support.

The feedback poll at the conclusion of the final session asked participants about their satisfaction with the content, format and impact of the webinar. In the poll, all participants were either "very" or "moderately" satisfied with the format and content of the webinar, with 78% indicating they were "very satisfied" with the format and 91% "very satisfied" with the content. Additionally, 70% of participants responded that they were "more optimistic" regarding the outlook for gender equality in the workplace as a result of the webinar, and 91% were "likely" to "extremely likely" to follow up on some of the actions suggested in the webinar.

A few participants were shy regarding the speed networking activity, and occasionally asked to be left out (remain in the "main room"), however participants were often observed to be smiling, laughing or attempting to continue cut off conversations upon returning from the breakout rooms. This set a great tone for the rest of the program. Participants who wished to be left out of the activity did at times present a logistical problem for the organizers as they had to manually exclude these participants from the breakout room assignment feature. With more than 20 participants there was a need to build time into the program to exclude those who wished not to participate. This was less of a problem for sessions which began with the speed networking activity, as participants could simply leave and rejoin the event when the presentations were scheduled to begin.

The polls were also effective at engaging participants, personalizing the webinar, and setting the tone during different moments of the program by getting participants to smile or laugh with the opening poll, then peaking their interest before breaks. Consistently over 90% of participants chose to answer each of the 3 polls per session. Early participant departure from a session was surprisingly rare, and usually accompanied by a public or private message to the organizers where the participants expressed gratitude for the event, regret that they had to depart the session early and questions about how to access recordings at a later time.

Following the conclusion of the webinar a final report providing an overview of the webinar content and recommendations for action for those who missed all or some of the sessions, or for those who prefer a more condensed information format, was published on the SVIN website[4]. The New Normal Report has been accessed over 150 times at the time of writing. The recordings of the webinar available on the NCCR Digital Fabrication YouTube Channel[5] have been viewed over 600 views at the time of writing.

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[4] https://svin.ch/wordpress/events/webinare/
[5] https://www.youtube.com/playlist?list=PLx4_UehA-vHdmvnsPM3hhM7_3qPvYDg79

BOX 3: Main Takeaways

- Relative to physical meetings, virtual meetings present unique opportunities and challenges that must be accounted for by leaders, who must make adjustments to the program and format accordingly.

- Increasing participant engagement is a crucial element for effective and impactful webinars.

- Planning for and investing in program elements that activate participants is key to participant engagement.

- Two program elements that were effective at engaging participants and setting the tone of The New Normal webinar were Speed Networking (see BOX 1) and periodic Zoom polls.

Discussion / Feedback and reflection

The purpose of The New Normal webinar was to optimize format and content to provide an engaging and interactive online environment where participants could not only inform themselves but also share their experiences, connect and bridge the virtual distance. The organizers consider the webinar a success because of recurring participation, participant engagement and spirit, active contributions to the Tales session, and positive feedback on the format and content.

Motivation to adapt the format

When the organizers began the webinar planning, most work meetings, lectures, presentations and seminars had necessarily been transferred to the virtual setting. Oftentimes, this transfer was barely successful because the specific properties of the virtual space with its many challenges and opportunities were disregarded. Many participants of online events reported that it was difficult to concentrate during long online presentations. Not being physically present with others created a sensation of augmented passivity and isolatedness. A similar impression was reported anecdotally by many presenters who had no chance to develop a sense of their passive audience, which made it difficult for them to be responsive and deliver an engaging talk. The feeling of connectedness was lacking on both sides. In so many ways it had become obvious that the transfer of meetings, lectures and courses from physical to virtual space required far more than simply delivering the same content in the same format in a new virtual setting. In order to design and implement interesting and engaging online sessions, the organizers believed the shift from physical to virtual setting required a significant adaptation of format.

Prioritizing participant engagement

A few of the reported positive benefits of remote meetings and webinars include the use of polling, the chat function, and the ability to enhance relationships by the intimacy of attendance from home (Karl et al. 2021). Both the polls and the speed networking in small groups were designed with the foremost aim of warming up participants, making them give up their passive role as listeners and get actively involved - both in terms of content and in terms of networking with the other participants. It was also intended to facilitate the feeling of connectedness and interaction between participants and with presenters. These elements and the expected effects of their implementation were considered essential for a successful webinar by its organizers. In addition, the webinar was designed in two parts, speed networking and presentations, with programmed breaks in between.

It has been reported that meeting participants feel strongly that cameras should be kept on during video conferences and that not doing so can impede communication and signal disengagement or disrespect (Kuzminykh & Rintel 2020b, Karl et al. 2021). To avoid these

negative consequences the organizers asked participants to mute their microphones when not speaking and during presentations, keep their camera turned on, and to properly introduce themselves when joining a discussion. The organizers noted the high level of compliance with these rules and interpreted it as a consequence of effective community-building and engagement. In the future the organizers will advocate even more strongly for participants to keep their cameras on, citing the collective advantages.

Reflections for the future

Even though the format of The New Normal webinar was a success, the organizers would like to make a few suggestions for improvements. First, the 2 hour sessions were difficult for participants to fit regularly into their schedules and at times felt a little too long. The time was often filled, however, by speakers who went over their allotted time frame. Existing research shows that meetings that are poorly led or that go over time can increase participant stress, fatigue and perceived workload (Luong & Rogelberg 2005, Rogelberg et al. 2006). For future webinars the organizers will limit sessions to 1.5 hours, will lead the sessions with more clarity, confidence and efficiency and will increase their efforts to coach speakers about engaging with the audience and keeping within the program time. The organizers feel that increased coordination with speakers always pays off, however it does represent a significant increase in workload. For example, although the Speaker Guidelines precisely defined speaker responsibilities like deadlines for sending biographies, abstract and slides for review, very few of the speakers adhered to them. Weighing the pros and cons, the organizers would still advocate for the use of the Speaker Guidelines, but with added email reminders and follow-ups.

Another strategy that represents a significant increase in the upfront workload of organizing a webinar is to integrate program features like breakout rooms, poll and chat functions in creative ways to engage participants and personalize the content. In the future the organizers will use these tools even more to progressively increase and maintain active participation during sessions. An additional activity that was not used in The New Normal webinar but that the organizers plan to use in subsequent webinars are questions posed by the moderator, for which participants are given time to answer in the chat, but that are submitted simultaneously by participants. This encourages all participants to answer, and not just passively read the answers of others, and can also give an impression of the spread of ideas within the group. The organizers felt that more than anything else these activities, when carefully prepared and efficiently executed, were more than worth the extra time spent designing them because of the atmosphere and engagement they created.

One area of difficulty for the organizers of The New Normal webinar was promotion and registrant attendance rate. It has been suggested that the average no-show percentage of virtual events can go up to 35%, which is slightly higher than in-person events, however some of the webinar sessions saw only approximately half of registrants show up. Solutions proposed by the organizers include last-minute reminders, sending "goodies" such as an apero pack by mail for a first or last webinar session to lighten the atmosphere and provide added motivation to commit to joining, and increasing anticipation of and link between subsequent sessions by delivering a "teaser" at the end of a preceding session. The final panel discussion session of The New Normal webinar saw the most participants, likely due to increased advertising efforts and the summarizing and concluding aspect of the content. In the organizers' experience, the more time and effort invested in developing a network and strategy for promotion, the more successful any event will be in terms of participation. The experience of hosting The New Normal webinar greatly expanded the organizers' network in the topic, which will facilitate the promotion of future events on related topics.

To make an entire webinar series more attractive it could also be possible to integrate one physical event into the program. The role of such an event in the overall program should be

carefully considered, however, as the audience might be too geographically distributed to give equal opportunity of attendance.

A final and important change the organizers will make for future webinar series is to develop a more robust feedback poll using a survey software (and not the Zoom poll function) and to send it out after the final session to all webinar registrants, not only participants. The Zoom poll function is limited to suggested answers, with no open answer options. The organizers consider feedback to be an essential part of organizing any event and will continue to optimize the feedback process for future webinars.

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The Conclusion is Inclusion: An Overview of Student Views on Diversity in the Context of European Technical Universities

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Abstract

Diversity and Inclusion are key elements of ETH's value system. ETH Zurich, a leading technical university, prides itself with its global eminence in teaching and learning. The VSETH, the student union of ETH, has dealt often with this topic and its many aspects in various forms of exchange. Although ETH is making progress in the right direction, the students see more possibilities to improve the situation of diversity and inclusion. As discovered in #wiegETHs? survey which the VSETH held in the year 2019, international students, in particular, are faced with the challenges of integration. In addition, the current pandemic with its isolationism makes the situation even more difficult for them. During the IDEALiStiC (IDEA League Students in Conference) conference in December of last year, students from the five leading technical universities of Europe met virtually to discuss the teaching and social life on campus during and after the pandemic. In their concluding position paper, they found that the social integration and inclusion of international students was a focal point in the discussions. Most participants agreed that efforts have to be made continuously to improve these values to ensure a healthy and progressive future for the universities.
In this paper, we outline what the VSETH does in the field of equal opportunities and propose further ideas for improvement of inclusion and diversity in the context of the ETH. The main focus lies on an analysis of the students' view of the current situation. Our personal experience, as well as the work done by our predecessors and colleagues, will be used to describe this work in progress.

Introduction

Diversity and Inclusion play a key role for the future development of ETH. These aspects are a great challenge for the university. From listening to every-day conversations, it was evident that many international students felt discomfort in the university's environment. ETH is confronted not only with the difficulties of inclusion, but also with the topic of diversity. The office for equal opportunities of ETH writes in their 2019/2020 gender-monitoring report that 32.3 percent of women studied at ETH, a female-to-male ratio which depicts the lack of gender diversity (Hettlage 2020).

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Additionally, the need for a more inclusive environment for all students exists and ETH is making the diminishing of stereotypes in gender an integral part of the agenda (ETH Rat 2021). Based on the awareness of these existing problems, a study was conducted by the VSETH to gather more information on the students' wellbeing at ETH. This study, the #wiegETHs? survey, managed to acquire a response rate of 6420 students, corresponding to a total of 42.2% of the ETH students in the year 2019 (VSETH 2021b). The following paragraphs show the study's motivation, methods, and survey design specifically in the context of inclusion and diversity. This is followed by an analysis of the results of this study and a discussion of its impact on diversity and inclusion. After integrating the topic into the context of ETH and its environment, the paper gives an overview of the international work in the framework of the IDEA League. In summary, both the internal and external efforts are combined to emphasize the importance of diversity and inclusion as values that have to be continuously fostered.

Development and Creation of the #wiegETHs? Survey

The #wiegETHs? survey was held in the spring semester 2019 and acted as a fundamental reference point for students' wellbeing at ETH (VSETH 2021b). A subgroup of VSETH, the working group for equal opportunities, carried out this survey and was supported by gfs.zurich, a company specializing in the conduction of surveys to ensure the high quality standards of statistical considerations. The questionnaire was sent out to all Bachelor and Master students of ETH Zurich. A list of all questions asked to the participants is published on the website of VSETH (VSETH 2019b). From this list, it is apparent that most of the questions refer to one of the following topics: mental health, discrimination, student wellbeing and inclusion and diversity. Besides evaluating the ETH-wide results, an analysis was made separately for all the individual academic departments. In this process, a member of the VSETH working group for equal opportunities presented the results to the department heads and representatives of the faculty student associations. Furthermore, the working group analysed the situation and discussed possible measures for improvement with the academic departments.

In addition to the individual departmental evaluation of the results, the VSETH wrote five action papers (VSETH 2021a; 2019a; 2020c; 2020a; 2020b). The topics of these action papers include the general study situation, sexism and sexual harassment, LGBTQIA+ students, mental health and foreign students. The overall focus is to connect these sub-topics to the overall wellbeing of the student body.

Results of the #wiegETHs? Survey

The following paragraph gives an overview of the topic "Inclusion and Diversity" at ETH and particularly focuses on how foreign students are being affected. The study found that in the year 2019, 21% of the students who are not from the German-speaking part of Switzerland stated that they had been disadvantaged on the basis of ethnicity, origin or language (VSETH 2021b).
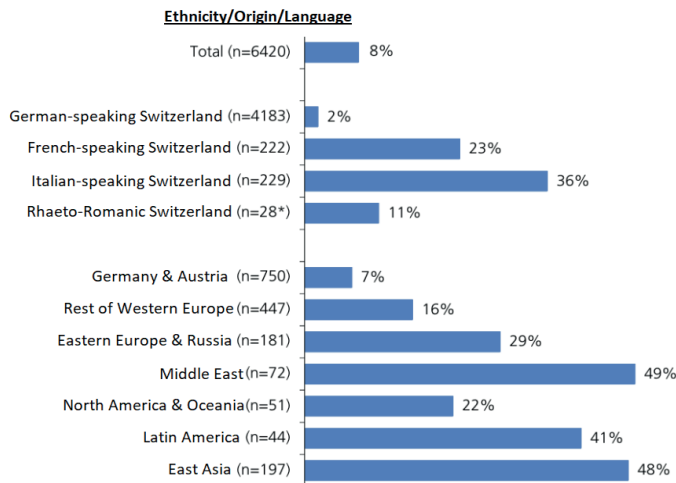
Figure 1: Perceived discrimination of ETH students due to language origin or ethnicity (VSETH,2021).

This is a large number, especially when put into the context of ETH having an enrolment of 22'193 students in 2019. The graph in Figure 1 shows the results of the percentage of students that had experienced a disadvantage at ETH. However, it still includes the German-speaking Swiss students in the calculated number, which results in a total percentage of 8% instead of 21% for foreign students.

To specify, the disadvantages were then categorized further, which is illustrated by the graph in Figure 2. The data in the graph in Figure 2 illustrates the exclusion and the acts of aggression directed towards specific student minorities. This data convinces the VSETH that measures need to be taken to fight discrimination with regard to origin, ethnicity and language.

Figure 2: Proportion of ETH students having experience exclusion and aggressive behavior due to race, nationality or religion (VSETH, 2021).

The measures proposed in the action paper on international students are divided into the following categories and are found in the final report of the #wiegETHs? survey:

social integration, discrimination, and language barrier (VSETH 2019a). For the category of social integration, the positio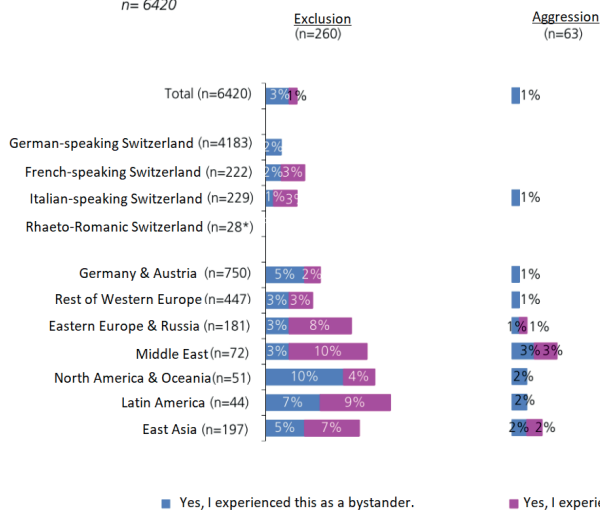n paper introduces the idea of a welcome week before the start of the semester as a measure to acclimate and integrate the international students into the ETH community (VSETH 2019a). This includes integrating these students into a new country and culture and recognizing that they need support to build a social network in their new city. Efforts in this direction will be implemented for the students starting in the autumn semester 2021. In regard to some of the socio-psychological topics in the survey, it was suggested that the individuals affected should be invited to discussions and dialogs before deciding on measures for change. By including the individuals affected in the process, one is not only promoting an inclusive environment, but also making sure that optimal measures are found to address the challenges. Another project proposed for the sake of fostering inclusion is the buddy program (VSETH 2019a). This was presented in a position paper and many faculty student associations have already put this into place. In this program, new students at ETH have a chance to pair up with more experienced students who can help them with their integration. The significance of buddy programs has long been recognised. Sandhu writes in a paper from 1994: "To help foreign students combat loneliness, it is imperative to develop a social network through a planned buddy system including both national and international students" (Sandhu 1994). To improve social integration, the VSETH team also suggests that a more targeted promotion in events for international students should be offered (VSETH 2019a).

An inclusive environment cannot exist without fighting against discrimination. The gravity of the negative consequences of international students being victim of discrimination has been emphasised by Smith and Khawaja (Smith and Khawaja 2011). The key to avoiding such consequences is awareness. The position paper proposes a voluntary awareness training along with a publicity campaign showing the advantages of a multicultural environment and making people aware of everyday racism (VSETH 2021b). Because every student should be aware of the rights they have, we propose that ETH create a summary document including the most important rights of an ETH student. This document then can be presented in the introductory lecture for first year students. The paper also suggests that this document can be presented in a flyer in the "ersti-bag" which every student receives during the first day of university.

Moreover, VSETH has realized that the movement towards a bilingual environment is highly crucial. Because English has taken the role as the global language, it is the most functional and easiest to use for communication among international students. The translation of documents and information channels from the German language into English is an important step for including all students. According to the position paper, the German courses at the language center are quickly booked up; therefore, the financial resources of the language center should be increased to raise its capacity and facilitate inclusion. To become an inclusive environment, the same chances and resources should be open to all (VSETH 2021b). ETH should have a translation service for official or legal appeals because they have to be submitted in one of the national languages. Documents written in German which are important for political participation should be offered in English as well. This observation is in accordance with the conclusions of Chen, who recognised second language anxiety as one of the most important stress factors for international students in North American universities (Chen 1999).

Overall, the #wiegETHs? survey showed a real need for change and for tackling the negative results with concrete measures on both an academic departmental level and on the ETH institutional level. This created a momentum which led to the formation of new student-led working groups and invitations for the VSETH to act as advisors in many topic-related projects.

The VSETH supports and fosters the momentum created by other groups or individuals who want to add something to this positive directive. Student-led working groups such as the VCS Help desk, a student association lead support platform, or the D-BAUG mental health working group are important additions to the cause (VCS, n.d.). The VCS help desk is a contact point for chemistry students, who are victim of discrimination or sexual abuse and are seeking support. The D-BAUG mental health working group is a subgroup of the academic department of civil engineering, carrying out and planning activities to foster mental health.

The International Context: IDEALiStiC

Data presented in the sections of the #wiegETHs? survey results suggest that the situation of diversity and inclusion is troublesome at ETH Zurich. In this section, we analyze if the observations are specific to ETH Zurich, or can be broadened to the context of academic institutions in Europe. To this purpose, we introduce the results of the IDEALiStiC conference (IDEA League Students in Conference), which was held online in December 2020.

The IDEALeague is a strategic alliance of European leading technical universities. The IDEALiStiC is a biannual conference organized by the student associations of the IDEA League member universities. During these conferences, student inputs are gathered by ideation workshops. Five to six members of each participating university's student union are invited to take part, allowing for a broad representation and diverse perspectives. In regard to the topics of diversity and inclusion, the workshops organized as part of the conference held in December 2020 are of particular interest. Focusing on the vision of the post-pandemic university, the workshops were designed to gather best-practises and new ideas on how to foster diversity in the university and how to create an environment in which all students feel included. The first workshop focused on teaching. The participants were asked to write down keywords and short texts describing their vision of teaching in the future. The keywords and the short texts were shared anonymously between the participants and discussed in the plenum. During the discussion, the moderator emphasized the aspects related to diversity and inclusion. The second workshop focused on campus life. The workshop included two brainstorming sessions followed by a discussion. First, the participants focused on the reasons behind the importance of students taking part in campus life. Second, the participants gathered ideas on how to create a more inclusive campus life, which addressed the needs and preferences of all students independently of their background. Following the workshops, participants were invited to volunteer to write a position paper which summarized the conclusions of both workshops. This position paper is published on the IDEALiStiC website (Pfister et al. 2021).

Conference Results and Discussion

The position paper describes a situation which most international students experienced during the year 2020 (Pfister et al. 2021). The pandemic has led to social isolation particularly for international students arriving in a new country. These students face the impossible challenge of building up a network of friends or integrating into an existing community. The participants of the IDEALiStiC conference therefore ask the universities "(...) to proactively make sure that these students feel a part of the local community" (Pfister et al. 2021). For the workshop participants, this is particularly important in order to ensure that no mental health issues arise due to a lack of integration and inclusion. In the broader context, Rienties et. al. believes that universities are responsible for tackling these challenges adequately (Rienties et al. 2012). In accordance with Rienties et. al.'s recommendations, ETH works on improving international student integration and inclusion (Rienties et al. 2012). For example, the ETH administration has dedicated an office for this work. And this office and the ETH student associations have created a new, more extensive version of the "welcome day" for master students without an ETH bachelor.

Additionally, the position paper of the IDEALiStiC conference emphasizes the importance of assisting international students in the matters of housing and finances. The reasoning behind this recommendation is the difficulty for students to integrate in a local community if they are not living in the city, or if they are having to work long hours in the evenings or on weekends. This recommendation is also in accordance with the findings of Calder et al., who extensively describes what role housing and finances plays for international students in a West-Canadian university (Calder et al. 2016).

Finally, the conference participants expressed the opinion that semesters abroad are a good way of fostering the diversity of the university community and the intercultural sensibility of the students. The authors of the conference position paper state "(...) some measures should be taken for boosting exchanges and bringing them back to the pre-pandemic level" (Pfister et al. 2021). Guest et. al. backs this conclusion in a paper, which describes the initiatives the science faculty of the University of Melbourne take to foster the international mobility of their students (Guest, Livett & Stone 2016).

Conclusion

ETH Zurich has been working on improving their integration and inclusion throughout the last years by expanding its offerings and programs for international students. However, the results of the various discussions and dialogues of the interest groups concerning these topics clearly reveal that although much is happening, there is still much work to be done. In the VSETH´s #wiegETH? survey and the IDEALiStiC´s position paper we see that both the issues as well as the measures used to counteract them, are very similar. The importance of inclusion and diversity is therefore not an isolated problem of a single university, but rather a focal point in the academic system in Europe.

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Justice, Equity, Diversity, and Inclusion Seminars: What They Do and Do Not Do

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Abstract

Universities are increasingly acknowledging the importance of promoting social justice within academic communities. In this article, social justice practitioners from the Scientific Staff Association at ETH (AVETH) critically evaluate the role of seminar series in promoting social justice within academia. We use the 2020 AVETH Social Justice Seminar Series focused on anti-racism as a case study. We discuss the importance of seminar series to provoke initial action and reinforce positive behavior changes to equip individuals with the tools and knowledge to fight for systemic changes. We also provide concrete examples of actionable steps people can make at the individual and institutional levels to promote social justice using information sourced from the seminar speakers and their publications. We also disclose the limitations of seminar series and reinforce the importance of accompanying actionable initiatives and tangible goals. Our goal is to bring awareness to the importance of following up such seminar series with concrete actions that challenge injustice and promote practices of self-reflection to truly combat systemic discrimination in academic institutions.

Introduction

Have you ever followed a Justice, Equity, Diversity, and Inclusion (JEDI) document or seminar series around? Where does it go, who does it effect, what does it challenge, and to what and whom does it appeal? We are a group of social justice practitioners and members of AVETH, the Association of Scientific Staff at ETH, and we often ask ourselves these questions about our voluntary JEDI work. None of us are social justice scholars, but we are constantly encouraged to re-think our strategies of JEDI work. Firstly, because of the way our own identities influence our status in the academy, and secondly, because we want to better understand and champion for JEDI so that everybody at ETH has the chance to thrive academically and professionally. To attract greater interest on JEDI, we organized the first annual AVETH Social Justice Seminar Series in Fall 2020 focused on anti-racism and inclusion in institutions, classrooms, and labs. The seminars were recorded and are freely available here: https://www.aveth.ethz.ch/diversity-seminar-series/. Here, we will offer a different account of the 2020 AVETH Social Justice Seminar series that places this initiative in a critical context of institutional diversity work.

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To begin, we will discuss the motivation behind initiating the annual seminar series about social justice. Put simply, there were few other consistent opportunities to learn about social justice at ETH even though diversity is one of the five values of the institution. In fact, there remain relatively few opportunities to learn about JEDI at ETH, a sign that JEDI has historically not been highly valued; otherwise, it would be more alive in the ETH culture. What institutions value, becomes part of institutional culture. If your lab has lunch together every Thursday, eventually Thursday lunches become part of lab culture. If your lab only plans to have lunches but seldom does, this situation is comparable to ETH claiming diversity as a value, having an equal opportunities office, but JEDI not yet being core to the University culture. Of course, there are many bottom-up initiatives, but these alone cannot change the culture of ETH in the absence of consistent top-down support. ETH is a frame where certain issues have existed since 1855. If discrimination happens frequently (e.g. sexism, racism, ableism) or initiatives for anti-discrimination occur infrequently (e.g. events, discussions, and trainings about JEDI), then particular individuals and identities feel the burden of exclusionary cultures and the need to take up what has been estranged by institutions. With our privilege of higher education, we feel a deep responsibility to create opportunities for everybody to find an entry-point to take-up the cause of social justice to create a transformative culture of just and equitable opportunity. This seminar series was an entry-point for some and an opportunity to learn and sharpen new skills for others.

What a seminar series can do

A seminar series might be able to provoke an initial action or reinforce positive behavioral changes which better equip people to fight for systemic changes. As seminar speaker, Dr. Shaila Kotadia discussed, there are three main pedagogical areas to create individual behavioral changes for JEDI work: [1] critical understanding of identity and positionality, [2] exploration of the current and historical oppressive infrastructures that have arrested progress towards a just future, and [3] development of culturally aware praxis [self-reflection] to substantiate transformative and inclusive change (Kotadia et al. 2020). Of course, a four-part seminar series is not sufficient to deeply engage with these pedagogical areas, but it can be an on-ramp towards fostering greater anti-oppressive praxis. Dr. Kotadia additionally shared eight guiding questions when taking actions that should be routinely reflected upon by everybody seeking to make systemic changes (Table 1).

1. What are the dominant narratives or hegemonic views you hold and how have they kept you from seeing other's full humanity?
2. What are the skills/talents and power/privileges you have?
3. What community are you seeking to be a part of and why?
4. How and whom in the community have you been in conversation with regarding community needs? Please include three to five of the community-stated needs.
5. How does your praxis project integrate with (and enhance) the community-level work already in existence and the community's stated needs?
6. What is the potential sustainable impact/benefit of this project will have on the community and how could your power/privilege/talents contribute to sustainability?
7. How might you benefit from doing this project and how is this work you are doing transform the reality you and the oppressed are in?
8. Do the benefits to the community outweigh the benefits you glean from performing praxis? Please detail the benefit-balance in your answer.

Table 1: Guiding questions for self-reflection when taking actions for social justice. These questions were shared by Dr. Shaila Kotadia (Director of Culture and Inclusion, School of Medicine, 2020) during the 2020 AVETH Social Justice Seminar Series.

An additional goal of the seminar series was to share individual steps to promote inclusive teaching in the classroom and lab. Dr. Catherine Shea-Sanger provided clear and actionable steps for promoting inclusion in the classroom drawing from evidence based principles in

inclusive pedagogy and universal design of learning. Dr. Shea-Sanger emphasized that students learn more when they have a sense of belonging in the classroom and curriculum and how this can be best achieved by moving away from an 'accommodation model' to an 'inclusion model'. While this transition may be challenging, there are plenty of easily actionable strategies accessible to educators with little-to-no exposure to an inclusion model. For example, you could diversify your course materials, references, and examples to deliberately include traditionally less acknowledged scholars or cultural contexts in the curriculum. You can learn more about these topics and actionable strategies from her recent open access book (Sanger 2020). Dr. Bala Chaudhary discussed her recent paper Ten simple rules for building an antiracist lab (Chaudhary and Berhe 2020). These rules are summarized in Table 2 and provide an important blueprint for creating personal and institutional transformations. These two seminars provide actional steps that every member of the ETH community can bring into the classroom, their mentoring, and respective labs and offered the most tangible ways in which most participants of the seminar series can do something at an individual level to promote JEDI. While it is the responsibility of mentors, teaching assistants, and educators to teach and to mentor, many are doing so without any formal training. Thus, opportunities to learn more about inclusive pedagogy and universal design of learning would have positive effects that ripple throughout ETH.

The final seminar speaker, Dr. Maria Miriti also shared clear strategies to fight injustice in the fields of Science, Technology, Engineering, and Mathematics (STEM) and provided important clarity on the importance of making systemic changes. A key takeaway from this talk is that institutions cannot simply hire their way to JEDI. A recent editorial article published in Nature Ecology and Evolution claims: "As scientists, we have choices about who we hire, who we collaborate with, who we cite and what we teach. Admitting students and recruiting junior researchers and faculty is perhaps where the biggest failing of academic institutions occurs." (Black Lives Matter in ecology and evolution, 2020). This statement is inaccurate, as Dr. Miriti and others summarized in a recent response article (Miriti et al. 2020). Black and latinx students enter STEM at the same proportions as white students, but switch or leave majors due to inequities that privilege white colleagues (Rigle-Crumb et al. 2019). Thus, recruitment is not the biggest failing of academic institutions. Rather, it is the culture in academic institutions that deters retention.

	Description	Actionable steps
Rule 1	Lead informed discussions about antiracism in your lab regularly	Organize recurring events to read and discuss papers on anti-racism and social justice with your team. You can find papers *via* AVETH as the diversity group hosts a social justice reading club and maintains a reading list on their website. A good list is also available *via* the Diversity at Standford Medicine website: https://med.stanford.edu/diversity/content/certificate-in-critical-consciousness-and-anti-oppressive-praxis.html#resources
Rule 2	Address racism in your lab and field safety guidelines	When orienteering new members, explicitly include a statement about the importance of inclusion within your group, expectation of conduct, and how issues of discrimination can be dealt with in a safe environment. Learn about the Ombudspeople and Confidants and explain their roles to new team members: https://ethz.ch/en/the-eth-zurich/organisation/ombudspersons-and-trusted-intermediaries.html Share that if someone needs advice related to their work, including issues of bias or misconduct, that they can confidentially contact the AVETH counseling group: https://www.aveth.ethz.ch/counselling/counselling-info/

Rule 3	Publish papers and write grants with Black, Indigenous, and other people of color (BIPOC)	When collaborating, strive to be less insular and deliberately seek collaborations with BIPOC experts in the field from within and outside of ETH.
Rule 4	Evaluate your lab's mentoring practices	Have mentors in your lab ever been trained on effective mentorship? Read papers on effective mentoring that draw from evidence-based techniques and share with your group (*e.g.* National Academies of Sciences, Engineering, and Medicine, 2020; Montgomery and Page, 2018). Further, encourage or help students to find external mentors through cultural affinity-based professional societies.
Rule 5	Amplify voices of BIPOC scientists in your field	Make an effort to cite the work of BIPOC scholars when it is the appropriate citation. Following new scientists on social media or google scholar will keep you connected with new research.
Rule 6	Support BIPOC in their efforts to organize	Attend events organized by BIPOC scholars to learn about on-going efforts and show up to advocate for these initiatives.
Rule 7	Intentionally recruit BIPOC students and staff	If you are hiring for a new position, disseminate your job posting and identify candidates using professional organizations and listservs supporting BIPOC researcher and collaborations (*e.g.* www.minoritypostdoc.org/jobs, www.diversityinresearch.careers/, www.sareco.org/) and reach a larger audience when posting jobs on social media using specific hashtags (#BlackandSTEM, LatinxandSTEM).
Rule 8	Adopt a dynamic research agenda	Be open to and support projects that may fall slightly outside of your expertise because scholars from marginalized backgrounds tend to drive more innovative, cross-disciplinary work (Hofstra et al. 2020).
Rule 9	Advocate for racially diverse leadership in science	Nominate BIPOC scientists whom you admire for research awards. At ETH, you can identify teaching and research awards here: https://ethz.ch/en/the-eth-zurich/portrait/awards.html
Rule 10	Hold the powerful accountable and don't expect gratitude	Learn how to be an effective bystander *via* trainings and readings and identify people/places where you can report misconduct with options for anonymity. Advocate for your department or ETH to offer regular trainings on bystander intervention. Establish protocols within your group to report misconduct both within and outside of your lab.

Table 2: Ten rules to build an anti-racist lab shared by Dr. Bala Chaudhary from Chaudhary & Berhe (2020) and an additional column with actionable steps tailored to the ETH community.

Low retention of people from marginalized identities in STEM can only be countered by moving beyond performativity and via institutional changes. For example, Dr. Miriti discussed how current standards of success, which focus narrowly on productivity and fast science frequently neglect the higher teaching and service loads by many people of color who do not receive broader professional recognition. Indeed, diversity work is unevenly distributed among the people most affected by lack of JEDI. In addition to having teaching and service work go unrecognized, underrepresented groups produce higher rates of scientific novelty, but these innovations go un-recognized, are devalued, and discounted (Hofstra et al. 2020).

People from marginalized identities are also frequent targets of overt oppression. For example, exclusionary behavior is the major factor driving lesbian, gay, bisexual, and queer (LGBQ) STEM faculty members out of academia (Patridge et al. 2014). Both overt oppression and covert actions, including daily microaggressions or subtle jokes, are experienced by many within the ETH domain, as evidenced by testimonials shared during the 2021 Speak Up ETH campaign (https://www.instagram.com/speakupeth/). If institutions, including ETH, are serious

about increasing JEDI, the transformative cultural shift being advocated by those with less power in the academic hierarchy, will need to be taken more seriously and given more power with greater top-down support.

The limitations of seminar series and performativity

It is essential to acknowledge that a seminar series alone will not transform institutional culture. For this reason, it is important to disclose why everyone should be critical of these initiatives despite well-intentioned motivations. Creating an impactful seminar series is not easy, but in the scheme of creating transformative cultural shifts within academia, it is a relatively simple action. No seminar series can be a tick-box to signify commitment to JEDI. Commitment does not exist without other actionable initiatives and tangible goals. Seminar series without additional actions is performative, which creates a myriad of reinforcing issue, as discussed more below.

Diversity acts, such as a JEDI seminar series, can work to conceal and reinforce systems of oppression. As Sara Ahmed outlined in On Being Included: Racism and diversity in institutional life: "...diversity has a commercial value and can be used as a way not only of marketing the university but of making the university into a marketplace. Others have called this the 'Bennetton model' of diversity, in which diversity becomes an esthetic style or way of rebranding an organization." (Ahmed 2012). Seminar series can easily fit into an esthetic style because they inherently carry no commitment at either the grassroot or administrative levels. If a seminar series or JEDI initiative is used to create market value for an institution then it is about the politics of image and changing perceptions, not social justice.

Performative JEDI actions are not simply ineffective but inflict harm on the people they claim to support. For example, diversity documents can allow organizations to gesture that they are committed to diversity [or anti-racism] even when racist behavior goes unpunished and concrete diversity initiatives are lacking. More specifically, diversity documents have been weaponized by university communications to block the recognition of racism by students of color (Ahmed 2007). Performativity can also signal that an institution is more diverse and inclusive than it really is in the absence of true commitments to JEDI.

If you are planning a seminar series or panel on JEDI, we encourage you to consider how this event is part of a larger social justice context. By deeply reflecting on points 6-8 in Table 1, you will be able to plan more impactful JEDI projects and events. Practically speaking, it is critical to offer honorarium in a timely manner to seminar speakers for their work. If a potential speaker is a scientist, it is important to also consider giving them the opportunity to discuss their research. If you or a team member experiences discomfort because of the way somebody with less power speaks about justice, remember that most of society will accommodate your notion of civility – it is essential to not police the tone with which anybody with less power communicates. Often, important messages shared by a JEDI seminar speaker will make those who experience the most privilege (whether consciously or unconsciously) uncomfortable.

This article began by considering where a seminar series goes, who it effects, what it challenges, and to what and whom it appeals. To answer these questions, a seminar series does not go very far, even if it reaches a large audience like the 2020 AVETH Social Justice seminar series. However, such organized events can be a starting point for further actions, a component of a larger JEDI initiative/project, and begin to normalize discussions about diversity and inclusion within the culture of an institution. However, a seminar series without further actions challenges little and appeals and encourages to performativity JEDI initiatives, which hinders progress. As Angela Davis said in her recent Vanity Fair interview with Ava Duvernay, "Diversity and Inclusion without substantive change, without radical change accomplishes nothing."

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The new vessels of knowledge: Exploring the meaning of cultural diversity in the age of globalization of higher education at ETH

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Abstract

Universities worldwide, driven by the impetus to be more diverse, are increasingly imbuing an international outlook constituted by individuals from all over the world. ETH Zurich, like most universities in its league, attracts a significant international student pool: The 23'420 students at ETH are from 121 countries, with 30% of its master's and 53% of its doctoral students being international students (ETH Zurich 2020). Consequently, initiatives such as the Respect Campaign, the rETHink project, and trainings are steps towards ensuring an inclusive environment for the diverse community which constitutes ETH Zurich (Baumann 2020). However, there are important questions which arise in contemplation of what gives these initiatives substance: What issues do they seek to address and to what extent do they fulfill the prerogative to inspire and uphold ETH's values in learning and teaching? In this article, the African Students Association of Zurich (ASAZ)[5] seeks to explore these questions and, more precisely, tries to investigate what the interrelationship is between globalization of higher education and cultural diversity goals at ETH. By designing a research project that explores the experiences of domestic and international students with minority backgrounds, this article intends to contribute to diversity studies by showing how student initiatives and the issues that sustain them can be of incremental value to creating a more inclusive learning and teaching environment.

Introduction

Culture, from small to larger scales, can be thought of as a set of rules common to a group of people and by which they all agree to play. Let us consider a usual checkers player entering a game of chess. Based on the fact of there being a checkerboard, would one expect them to excel at the new game, solely relying on the set of rules they know from the former one? This simple illustration is an attempt at describing situations and initiatives ASAZ has collaborated on in recent years and which, in the sphere of global higher education, could be examined in a similar way: Graduate school applications that are rejected not because of the applicant's lack of competencies, but because they are unaware of certain standards in place, namely regarding how these same competencies are expected to be presented in a CV, a motivation letter, or an essay. An implicit rule and criterion which, in the local organizational culture, is just as crucial for the application to succeed. Though it may sound intuitive to some of us or common knowledge to others, is it really?

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Definitions

To effectively set the frame of the research project later, it is essential to first introduce and define the different concepts discussed in this article, starting with diversity. This concept in itself carries numerous components, which, as introduced in the results of the INVITED project, we will be referring to as dimensions (Claeys-Kulik et al. 2019). The general idea that it conveys is that there are different people and/or ideas within a social organization (European University Continuing Education Network 2018). Gender, sexual identity, disability, ethnic or socioeconomic background are dimensions that readily come to mind when talking about diversity. For this research project, we have chosen to focus on education and culture with the implicit aim to explore the diversity of experiences, i.e., to look into how individuals are experiencing the institution.
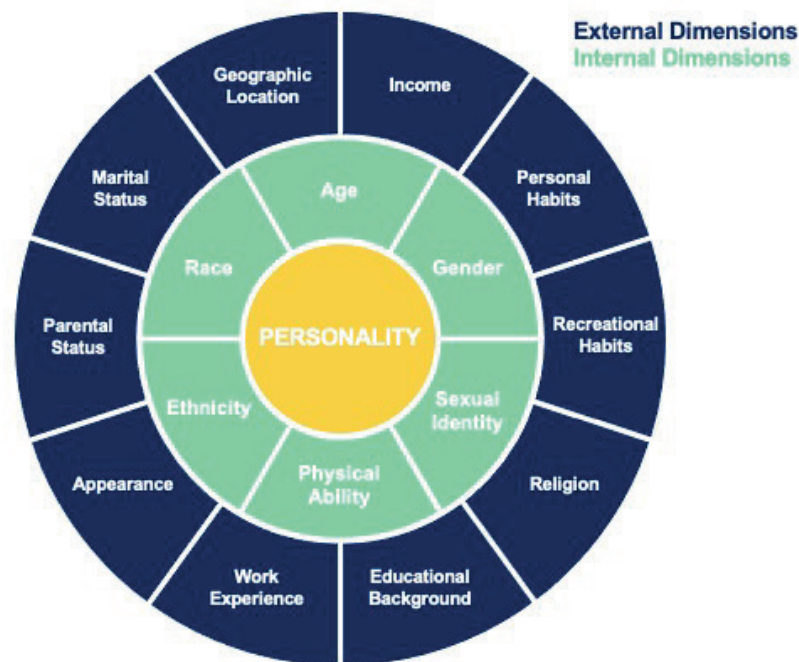

Figure 1: Three Levels of Diversity, adapted from The Four Layers of Diversity by Gardenswartz & Rowe (2003)

By diversity with respect to **education**, we understand the fact of considering the different academic paths that students have taken before and during their present studies at ETH, as well as the knowledge they carry. The notion of **culture** is a set of ideas and customs common to a group of people and which can be expressed, for instance, through values or even more concretely through languages. Moreover, culture adds an idea of time and, more commonly, of place to diversity (Cambridge University Press 2021). What this article and research project try to underline is how cultural diversity adds value to the ETH culture through its power to bring together different perspectives, build awareness, and come up with solutions to multifaceted problems.

On the one hand, the **globalization of higher education** is the process that allows new people, ideas, cultures, and knowledge to flow into the university. In that context, it is important to consider ETH as a pole that attracts, recruits, and also retains students from various parts of the world (ETH Zurich 2020). Ultimately, we can affirm that it is the mobility resulting from this attraction that is one of the driving forces for diversity on campus (Claeys-Kulik et al. 2019). On the other hand, **internationalization** is defined as "the process of integrating an international, intercultural, or global dimension into the purpose, functions or delivery of postsecondary education." (Knight 2003) Here, the dimension we focus on is the student body and, in particular, the **new vessels of knowledge**, those students with a **minority background**. Following the definition of the UNESCO Thesaurus, a cultural minority is a

"group of persons belonging to a culture different from that of the majority of the society in which they live." (UNESCO 2021) In that sense, **minority background** here refers to the fact of being fully or partly part of a cultural minority. These students are considered vessels because they bring and collect knowledge to and from ETH Zurich. As opposed to a stream of knowledge brought by globalization, the term captures the idea of individuals' singularity, which, more often than not, can be lost in data. As we will later discuss, the research will attempt to highlight individuals' experiences and narratives.

The new vessels of knowledge come from abroad or within Switzerland. That is why we find it pertinent to classify them into two groups: the **domestic students** and the **international students**. The first group includes all students who have obtained a secondary education diploma in Switzerland or who have at least partly gone through the Swiss education system upon applying to ETH. The second group includes students who usually come from abroad to pursue a degree from bachelor's level upwards.

Broaching the topics of diversity and internationalization requires us to nuance the concepts of **inclusion** and **integration**. With the former, we mean the removal of barriers, in order for all students to be able to enjoy the same experiences. This means it is the institutional system that caters and adapts to students' needs. While with integration the idea of bringing diverse groups of students together does remain, it requires them to adapt to the system (Eid 2018).

Problem framing

ASAZ was created with the aim of welcoming new African students and facilitating their entry into student life in institutions of higher education in Zurich. It also aims at bringing together students of African origin and be a learning environment for those interested in African cultures and issues. Understanding how international students from Africa experience diversity and inclusion at ETH, as well as considering the experience of domestic students of African heritage, the smaller proportion of ASAZ members, is key to achieving these goals. Furthermore, contributing to ETH's efforts to make the learning and teaching environment more inclusive and diverse is up to each one of us as students and also, as a diverse student organization itself, to ASAZ. The association is a crossroads of countries, cultures, and academic backgrounds, where people can connect, reflect, and learn from each other. It is important to us to act as a platform that voices stories of members and alumni*æ, from which we believe the greater ETH community can benefit to advance even further. Last but not least, as a large number of ASAZ members are among the 53% share of doctoral students recruited internationally, we expect their point of view to be particularly insightful. Considering current domestic and international students, but also alumni*æ allows us to cover a broader range of questions, some of which being specific to Switzerland, such as the local process of obtaining a secondary education diploma and getting access to university (Felouzis & Charmillot 2017).

Finally, starting from the ETH statistics and the share of students recruited abroad, we could design a general research structure as follows:

- The first aspects to be examined would be the university's aim and actions to be a global institution, as well as its federal status, which ultimately nurture diversity on two levels: nationally and internationally, with vessels of knowledge coming from different cantons and countries respectively.
- The transition from one academic system to another and expected standards would make up the second part. As touched upon in the beginning with the example of the application process, adapting to a university's bureaucracy in a foreign country, or even on a different continent sometimes comes with hurdles. The question here is whether the system considers international students' background, and if not, whether this possibly hinders diversity. This section should also be interesting to compare the requirements international students had to meet with respect to the academic degree for which they applied.

- The subsequent focus would be on the inclusion of these students in the lecture hall, especially looking at participation, identification, inclusion by peers and teaching staff, and possible biases. This section would also address the language barrier.
- The final aspect that was important to cover is the social and cultural integration of international students, as well as further initiatives than can be brought within the ETH community to facilitate this process.

Thus, our research should consist of a comparative analysis of a series of cases of students' experiences, both from the perspectives of the domestic and the international vessels of knowledge. Ultimately, its goal is to further the conversation on diversity at ETH, and most importantly to bring diversity in a valuable way that can yield sustainable impact and solutions.

Methods

Description

As the approach of this research will be explorative and descriptive, the methods used will be of qualitative nature. The data collection tools will be an online survey as well as 1-on-1 interviews. While the first tool should help us to reach more people, the interviews should allow more flexibility, in order to develop and delve into the specific topics mentioned in the structure in more detail. Furthermore, we expect these interviews to be a valuable instrument for the sought qualitative goal of this initiative. Lastly, an important question will be whether the answers in the surveys substantiate the information we will gain from the 1-on-1 interviews.

Pilot interview

In the preparation phase of the project, we conducted a pilot interview with an African alumna who did her Ph.D. at ETH Zurich. She joined from the UK, where she did a Master's in Public Health. She had done her undergraduate and her first master's degree in Buea, Cameroon.

The pilot interview was a way to test a selection of six questions extracted from our general structure:

1. Did the minority background of domestic/international students directly or indirectly affect their academic route? E.g., has it pushed them to pursue studies at university, and more specifically at ETH? Or have they, on the contrary, ever faced any hurdles because of it?
2. Were domestic/international students with minority backgrounds informed about prospects for studies at ETH? If so, at which level (primary, secondary I, secondary II, …) and/or through which means (e.g., Zukunftstag, Mathematical Olympiad, …)?
3. What were the diplomas of domestic B.Sc. students with minority backgrounds upon application at ETH (gymnasiale Matura, Berufsmatura + Passerelle, other)?
4. What is the highest level of education of the parents/former legal guardians?
5. How comfortable are international students in participating during lectures? How much do international students feel included by their peers (with respect to language, anecdotes, references, …)? How does their previous institution differ from ETH? (academically, culturally, on a personal level, …)
6. Could students with a minority background identify themselves with their lectures and professors? Was this important to them?

Coming from a very modest economic background, neither of her parents having studied further than secondary school, the alumna had to rely on self-information to find educational opportunities. For example, she found the Ph.D. program call on the website job.edu.uk.

She shared that her minority background did directly affect her academic route. First, she was delayed in her curriculum, because she had to wait for programs and admissions that would be inclusive of her, those being rare, some even bi-annual. Second, when she passed her

interview for a Ph.D. position at ETH, she did not get her desired position. Instead, she took the opportunities that were presented to her. Once she got enrolled, she still had to take one year of master's-level classes to prove that she had the required level to study at the university, which was an additional burden compared to Swiss and German students, she said. Our interviewee strongly felt that she must perform better than her non-minority counterparts, because she represented more than herself. Thus, the possibility of other African students joining the institution after her depended on her success.

Our alumna felt comfortable during lectures. She described that no particular effort was made to include her in the classes, but it did not bother her. She underlined not identifying with lecturers and professors, but this was not important to her and did not stop her from learning. She still mentioned that it would have been nice to have minority background lecturers. With her peers, she felt partially included and partially kept to herself. The culture was different and new, she explained, but she still tried to maintain contact with somewhat similar people.

One feedback she wanted to give was that, from her perspective, diversity at ETH included mostly Europeans and that students from other migration backgrounds had less visibility and access to the university.

Conclusion

Though only a glimpse thus far, the pilot interview has allowed us to address topics with our interviewee that are central in the conversion on cultural diversity in the learning and teaching environment. The scope of the questions also enabled us to catch a story. Of course, to get more insight or even effectively identify a trend, a larger number of cases is indispensable. Moreover, some aspects that will need to be considered meticulously in the actual research are survey and interview bias.

In a very similar fashion, the dual perspective of this prospective project could be extended more generally to domestic and international students with minority backgrounds within other cultural student associations, leaving room for a wide range of possible research focuses.

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Interview with Dr Raphaela Hettlage, ETH Diversity

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You are the new head of ETH Diversity since 1 September 2021: could you tell us about your background and new role?

I have a PhD in Social Anthropology and for my research I worked on the intersections of gender, migration and age. After my PhD, I worked in two institutions in Bern on the topic of gender and diversity. They were two different jobs, not research related; one position was in the Equal Opportunities Office for the City of Bern and, in the other, I was the deputy leader for the Equal Opportunity Office, University of Applied Sciences, Kanton Bern. Working for a City Council meant that our work and projects were determined by the decisions of politicians. At the University of Applied Sciences, my role was, among other things, to coordinate the Equal Opportunity commission, which had Delegates from all the departments, which are physically scattered around the Kanton of Bern. My experience of both politics and an educational context gave me the knowledge that, to develop a strategy, you really need to understand the context in which you are working, and the networks, in order to change perspectives.

I am not new to ETH, I originally worked here in 2001 in the Institute of Economic Research as a teaching assistant for Prof. em. Renate Schubert, the former head of the Equal Opportunity Office. In 2019, Renate Schubert invited me back to work with her again, on a project to create "EQUAL tools," a resource currently on our Diversity at ETH website. This experience means that I know ETH from a number of perspectives: from working within a research group with students and postdocs, and also working at the core of ETH. Now that ETH Diversity is situated in the Octavo in Oerlikon we are far away from the campuses and I do not have direct contacts to the students on the campus, which I miss.

My role is still developing. I feel very welcome in the new role, and the ETH community is ready to support an office under the new title of ETH Diversity. In the new format, and under the Vice President for Personnel Development and Leadership (VPPL) we plan to go out into the ETH community, to show ourselves and make visible what we do. It has not always been easy to work on the Diversity issue in an educational context, but now there is a wave of support – students, postdocs, faculty and professors (as well as the Schulleitung / Executive Board) pushing for improvements in this area. There is pressure for there to be projects, ideas and a vision for ETH on this topic. It means that the new office has been established in a very good climate. Our main role is to co-ordinate everything across ETH, to create a diversity strategy and an environment where people can collaborate and even strive for an inclusive culture. We want to help to focus people around diversity.

I am supported in this work by my great team, who have a range of perspectives and experience working at ETH and are very helpful. I also discuss the topics with Nadia Dörfinger, our new head of Collaboration and Diversity, the head of the Office of VPPL, Maximilian Buyken (who led the Equal Office temporarily in 2020/21) and his colleague Dr Sarah van Leeuwen. Our team is also well integrated in networks across Switzerland such as IDEAS, CESAR, and IARU.

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The ETH Diversity office was established in 2021 to replace the Equal! Office – can you tell us about the plans for the new office, its role and the vision for the future?

Equal! Office's name change arose after we sent an outline draft for a new Diversity Strategy to the ETH Executive Board. The Board approved the outline and assigned us the task to create a full diversity strategy in the next two years, which will be participative and consult the ETH community. It is very central to the new strategy that we consult, and do not work alone in one room, but rather encourage people to bring in their own ideas. Following the approval of plans for a newly developing diversity strategy, ETH President Joël Mesot asked us to change the Equal! office's name with immediate effect. The change happened very quickly and was easy to implement because it resulted from a directive from the university leadership. However, we are aware, that there is a danger that people will think that gender equality at ETH is no longer as important as before. We need to make sure that the ETH community knows that we are still focused on gender equality initiatives too. At the moment there is an urgency within the ETH community and the society as a whole to address issues such as systemic and individual racism, migration, social and educational background as well as accessibility and inclusion alongside with gender equality issues. It is therefore paramount to mention that whilst we are expanding our work to help create a more inclusive environment for work and study, thriving for gender equality will remain a priority. It will take an extra effort to keep this part of the ETH Diversity office's work visible.

We are examining the topic of integrating the aims of diversity into the study curriculum, aware of an exhaustion about looking solely at gender in this topic. It does remain important, for progressing gender equality at ETH, that there continue to be goals and targets in place. It may be hard to agree about them, and to reach them, but they need to be there. With Diversity and Inclusion, it is more difficult to define specific goals, because it is mostly about an inclusive culture. We need to establish a culture of inclusion that can shape ideas and will be based on justice, principles and equal opportunities.

The ETH Gender Action Plan is still part of our working life, but we are finding that it is less used in Departments and by the Executive Board. We need to find something else as we build the strategy for diversity. There will be a transition period for a couple of years, with the ETH Rat's five-year Gender Action Plan still being used at that level. We plan to incorporate aspects of the Gender Action Plan into the Diversity Strategy. The annual meeting of departmental representatives on the Gender Action Plans is currently being replaced by a Diversity meeting and we are building a network around the original gender delegates. We will also widen the ETH representation, for example with representatives from LET who work on diversity and inclusion in teaching.

In summary we have many topics that the ETH Diversity Office will address:

- A Diversity Strategy will be delivered in the next 2 years.

- We continue to focus on reconciliation of study/work and care responsibilities on all levels.

- Advancement of women at ETH.

- Implicit/unconscious bias in the workplace (working with the section on Leadership and Development in VPPL).

- Inclusion in Educational Development at ETH.

- Equality monitoring and Analysis.

- How to implement inclusive communication at ETH.

We need to live Diversity at ETH and not be continually examining visions and/or implementing random quick fixes.

The Equal! Office was a place that the ETH community contacted about gender and diversity issues in their teaching and learning environment: what are the plans for the future responses to these kind of diversity enquiries?

We would like ETH Diversity to be a hub for all the questions from the ETH community on diversity issues. We hear from working groups within departments, students who think that there should be more diversity or gender consciousness in lecturers' presentations, or complain about diversity-related teaching problems. We can gather problems together as resources for the ETH community and share them with ETH members developing diversity and inclusion. Another problem is that lecturers may not respond properly to issues that arise in the classroom environment and, as result, worsen the situation. Faculty need training in advance to help them to respond well to such situations.

What responsibility or role has ETH Diversity in supporting issues in the teaching and learning environment? What is your scope for action?

We can encourage the creation of inclusive classrooms with good teaching, where people are welcomed from different backgrounds, ideas and treated with respect. We would like to see their background used and an awareness in the teaching staff about biases. We are in favour of this approach and our scope for action is to promote this vision. Our strategy will be to facilitate the view at ETH that inclusive teaching and classrooms are part of an inclusive culture. Whereas research is a core competence at ETH, teaching is also an important focus, and ETH is working on the balance between research and teaching, and how to promote diversity in those areas. The new strategy will also look at how to achieve a constructive way forward in what could be perceived as two separate issues instead of an interactive framework.

How do you envisage that LET and ETH Diversity could work together on implementing diversity in curriculum and faculty development?

We can work together to foster an inclusive culture at ETH – tools, theory, tactics and developments. Teaching should be inclusive teaching. We can reflect on ETH culture. It will take time to change things. We need to clarify what we mean about how to make this happen – hence working on the Diversity strategy now!

Inclusive teaching at ETH. What is meant by this and what are the implications for learning and working at ETH?

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Abstract

Under the title "Hindernisfreiheit an der ETH Zürich", ETH is committed to the inclusion of people with disabilities. In addition to structural measures and adaptations, organisational, and information-technological aspects also play a central role. To enable all motivated students to participate in their studies and academic life with equal opportunity, regardless of any special needs and circumstances, teaching in particular is becoming the focus of attention.

A prerequisite for inclusive teaching is the availability of accessible digital learning materials. "Accessible" means that these learning materials can be used efficiently and effectively by all students, regardless of sensory or physical disabilities or of special needs due to neurological characteristics. Many of these students are true masters of applied problem-solving strategies, but unfortunately, still today, some content remains inaccessible.

The increasingly ubiquitous digitalisation of all aspects of life, including academic life, is a blessing for the worldwide efforts to increase educational opportunities also for people with disabilities. In many cases, the availability of digital learning content is a prerequisite for its accessibility. Print is not universally accessible! Flying in the face of these opportunities, still very little publicly available digital content is accessible – and the same applies, to an unfortunately even greater extent, to teaching materials.

Digital learning materials include not only textbooks, but any informative content that is relevant to students' everyday lives. This includes electronic user interfaces of learning and information platforms, examination systems, teaching applications, document-filing systems as well as their respective content. People with disabilities often depend on electronic content being well-structured and machine-readable, in particular, that the content can be displayed in different ways, for example, greatly enlarged, or that images or multimedia have appropriate textual alternatives.

Ensuring the accessibility of information and learning content on learning platforms, in scripts, and in other documents cannot be achieved without the active assistance of all ETH stakeholders involved in the creation and deployment process. Procurement managers are encouraged to acquire accessible software and frameworks. Developers must ensure that their products can be operated using both keyboards and computer mice, and that the content can be displayed as flexibly as possible. Content creators need to ensure that their content is well-structured with rich, explicit semantics, so that it can be navigated efficiently and without additional barriers using screen readers (software that allows blind people, for example, to

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read on-screen content in spoken language or Braille). In fact, it has been shown that content created with "accessibility in mind" is generally easier to understand – for everyone!

Of course, all those involved are not left alone with these challenges. The administrative department Educational Development and Technology (LET) supports all members of ETH in all aspects of the implementation of e-accessibility: in the transfer of knowledge through practice-oriented training, targeted courses or individual consultations, or by providing and preparing the relevant resources.

Inclusive higher education

The academic world is becoming increasingly diverse and this trend is likely to accelerate in the future. Gaisch and Aichinger (2016) identify five facets of diversity and map them in the Higher Education Awareness for Diversity (HEAD) Wheel reference framework: demographic, cognitive, disciplinary, institutional, and functional diversity. Each facet brings its own requirements for adaptation for higher education.

ETH Zurich is facing up to the challenges. With the university-wide programme "Hindernis-freiheit an der ETH" (Storjohann & Weltner 2021), it is committed to the goals of an inclusive, diverse and accessible university. The programme focuses on equal-access opportunities for all members of its academic community, and its main goal is to ensure unencumbered access to studies for people with disabilities or other special needs.

This article explains what is meant by accessibility in the context of teaching, and what implementing the requirements for accessible teaching means for the university and its members. The focus is on the provision of accessible digital learning materials. Didactic aspects are discussed only marginally for the time being. Based on the experiences of the current implementation of accessible teaching at ETH, it discusses potential stumbling blocks and how best to address them.

The increased interest and commitment to inclusion, diversity and accessible education is by no means a short-term fad, but rather a result of the ongoing struggle of minorities for recognition and self-determination that has been going on for decades. In the USA, but also in other Anglo-Saxon cultural spheres, accessible educational institutions with their competence centres are now a matter of course and have become indispensable. With an estimated 15-20% (Officer & Posorac 2011) of the world's population relying on accessible content in some way, accessible educational resources are becoming an important competitive advantage. Where this competition plays out, a lack of accessibility is readily perceived as a lack of customer orientation and social responsibility.

The conditions in the USA did not develop by chance but have been largely triggered by the introduction of relevant laws (ADA 2020). In Switzerland, too, ensuring the accessibility of public institutions and their information and service offerings is regulated by legal regulations (EBGB EDI 2021). At the federal level, these include the prohibition of discrimination in the Federal Constitution[4] and the Disability Equality Act (BehiG)[5]. Since the UN Convention on the Rights of Persons with Disabilities came into force in Switzerland in 2014 (Fedlex 2020), stakeholders and disability organisations are also hoping for increased legal pressure on private providers.

However, legal considerations are not the best reason for universities to get involved in the inclusion of people with disabilities. The commitment to inclusion and diversity is an expression of a humanistic and liberal idea of society, where every person can develop freely according

[4] www.fedlex.admin.ch/eli/cc/1999/404/de#a8
[5] www.edi.admin.ch/edi/de/home/fachstellen/ebgb/recht/schweiz/behindertengleichstellungsgesetz-behig.html

to his or her own wishes, and it is simply the right thing to do! An inclusive education system is an investment in this society. For people with disabilities or any special needs, this opens up many exciting employment opportunities, facilitates social participation and promotes the independence, self-determination and self-esteem.

For the higher education institutions themselves, opening up to people with disabilities also means access to a greater diversity of promising talent. People with disabilities have a wide range of talents – not in the least precisely because of their disabilities and the alternative perspectives, acquired skills and developed problem-solving strategies associated with them. It is no coincidence that the call for accessible education is attracting increased interest in Europe now, 30 years after the first website was launched at CERN. Sir Tim Berners Lee expressed the importance of his invention, the World Wide Web, for the inclusion of people with disabilities as follows:

> "The power of the Web is in its universality.
> Access by everyone regardless of disability is an essential aspect."

Unfortunately, the hopes that digitisation would by itself lead to universal accessibility have not yet been fulfilled. However, it can be stated that the digitisation of information and communication technologies (ICT) is an important prerequisite for the accessibility of information and communication channels; both are important aspects in teaching.
Especially now, when strategies for digital transformation are being revised and optimised, it is the right time to also consider electronic accessibility (e-accessibility) from the very beginning and to establish it as an important requirement in the digitisation process.

Digital accessibility as a prerequisite for the inclusion of people with disabilities

Digitalisation holds enormous potentials for inclusion and for equal and self-determined participation in the information society and in society in general. Many opportunities would be inconceivable without modern digital information and communication technologies (ICT). Electronic services and information offerings hold the potential to make accessible to people with the most diverse disabilities a multitude of activities necessary for a self-determined life:

- Thanks to online newspapers, blind people can independently call up up-to-date information and have it read out to them or printed in Braille.
- People with a wide range of visual impairments can adapt the visual representation of screen content to their individual needs – by enlarging, changing the font, individualised colour schemes, and much more.
- People with motor impairments can operate technical devices with the help of various aids. These range from special keyboards, push-button devices, eye-tracking devices (eye movement controls) to speech input software.
- People with mobility impairments can overcome many everyday challenges online from home: from administrative procedures, banking and insurance transactions, ticket purchases, hotel and travel bookings to online shopping.
- People with speech or other communication difficulties can communicate online through appropriate channels: orally, in writing, in sign language.
- People with learning disabilities or cognitive impairments can access texts in easy language, supplemented by symbols and animations, or have texts read to them.
- People with hearing disabilities can make use of subtitles or text transcriptions, which can now be generated automatically with little effort and in respectable quality. Information for people with hearing disabilities can be prepared as sign language videos and made publicly available to all.

Equitable access to such offerings through individual adaptations or through the availability of content for alternative sensory channels would be possible without any problems with the technologies available today. Would be! Unfortunately, this potential is hardly considered today. A prerequisite for these scenarios to become reality is the accessibility of the ICT used.

Who benefits from accessible digital content and user interfaces?

The shortest possible answer to this question is: everyone. Of course, given severe cognitive disabilities or lack of access to the necessary technical infrastructure, this statement is presumptuous. Nevertheless, in our understanding, e-accessibility targets all conceivable types of disabilities and special needs. As can be seen from the examples listed above, the focus is particularly on sensory, motor, and cognitive disabilities. The needs, problem-solving strategies and requirements concerning motor and sensory (visual and auditory) disabilities are largely known. As far as special needs due to cognitive characteristics are concerned, the path to solutions is less clear, not in the least because the individual needs and the corresponding requirements differ greatly, in contrast to the requirements for people with visual, auditory, and motor impairments; they cannot be so easily summarised in general guidelines.

Concept of disability

At this point, it is worth taking a look at the ICF/WHO bio-psycho-social concept of disability as it is applied today (WHO 2002). In contrast to earlier models, this model of disability does not focus on either individual physical impairments alone or social factors alone, but rather on the interplay between physical, personal, social and environmental factors and their impact on activities and participation opportunities of persons. In this context, we now speak of damage to bodily functions, limitations in certain activities and disabilities in people's participation in various aspects of social life. Disability thus manifests itself mainly in the interaction of people with their immediate physical and social environment, that is, in participation.

Principles of digital accessibility

Measures to improve the accessibility of electronic user interfaces follow different approaches, just like people with disabilities develop different adaptive strategies to deal with their limitations: by compensating for a damaged sensory channel with the help of other senses, by intensified use of memory or by direct adaptations to the immediate environment. In the case of ICT, these range from zoom (magnification) functions on screen, the use of large screens up to special assistive technologies (ATs). These include complex technical devices and software, such as speech output through screen readers, speech input, eye-tracking devices, augmentative and alternative communication (AAC), as well as special input devices for people with severe physical and motor disabilities who cannot use a computer mouse.

For individual adaptations and assistive technologies to work in interaction with the external environment, in our case with electronic user interfaces, certain conditions must also be met in that external environment. In the physical world, this is exemplified by ramps for wheelchair users.

Bolfing (2021b) suggests five easy-to-remember aspects that largely cover the prerequisites for accessible digital content and user interfaces:

1. **Flexible output:** Content can be displayed flexibly: Texts reflow when enlarged, so there is never any need to scroll horizontally. Page layouts adapt to the size of the window. Font and background colours, line spacing, fonts, etc. can be adapted individually.
2. **Flexible input:** Applications and interactive elements can always be operated with both a computer mouse and a keyboard. Computer mice are representative of other pointing devices such as mouth mice or eye-tracking devices. Keyboards are representative of

serial input devices based on special, sometimes few, keys, as often used in individual devices for people with severe physical disabilities, e.g., quadriplegics.

3. **Explicit semantic information:** Much of the information that we, as trained sighted people, immediately and implicitly perceive and process when viewing screen content is not accessible to blind people. These visual cues must be added actively and explicitly to the content as so-called semantic information. On websites, this includes, for example, labels of page areas such as header, footer, navigation or main areas, correct structuring of content by means of heading levels, correctly formatted lists and tables, correctly labelled buttons, or form fields, but also alternative texts for images or icons. Modern widgets, such as overlays, drop-down menus, accordions, sliders, or various multimedia players, etc., pose special challenges here. This semantic information allows machine readability and is an indispensable prerequisite for the functioning of complex assistive technologies such as screen readers or speech input software.

4. **Multimedia and images:** Information that is conveyed by means of multimedia or images is always provided in at least one additional sensory mode. We call this requirement the two-senses principle. Information conveyed visually in videos and images must also be provided auditorily or as text. Audio-only content, or audio content in videos, must also be provided visually, e.g., as a sign language video or as text (e.g., as (closed) captions).

5. **Colours and contrasts:** All relevant content such as text, icons or form field borders must exceed a minimum contrast ratio to the background, and essential information must not be presented using colour alone (e.g., colour legends of diagrams or reservation systems).

Guidelines and standards

While the above five aspects of digital accessibility help to develop a comprehensive understanding of the at times complex requirements for accessible ICT, they are of limited use as concrete guidelines for action.

Fortunately, at this point we can draw on the valuable groundwork done in the field of universal design and digital accessibility. The first general design principles for accessible architecture and accessible product design became known as Universal Design in the 1960s (The Center for Universal Design 1997). Even back then, the requirements requested that products 1.) be usable by as many people as possible, 2.) be adaptable to individual needs if necessary, and 3.) also be compatible with common assistive technologies.

The Web Content Accessibility Guidelines (WCAG)

In 1999, the first version of the today internationally established Web Content Accessibility Guidelines WCAG for accessible web content was published as a W3C standard. This was followed in 2008 by WCAG 2.0, which still form the basis for most legal regulations for digital accessibility worldwide. In WCAG 2.0, the guidelines were no longer formulated specifically for HTML, but were technology-agnostic. To persist in the rapidly changing technological environment, the guidelines have since been formulated in such a way that they can be applied equally to any digital user interfaces and content, regardless of the technological implementation. In 2018, WCAG 2.0 was followed by the current extension of WCAG 2.1 with 17 new success criteria, which closed known gaps in WCAG 2.0 regarding touchscreen operation and cognitive impairments. Nine additional success criteria are expected in version 2.2, which should be updated by the end of 2021.

From version 2.0, the WCAG are divided into the four POUR principles: Perceivable, Operable, Understandable and Robust. In version 2.1, these four principles contain a total of 13 guidelines with a total of 78 so-called success criteria, which in turn can be assigned to 3 levels of conformity. The success criteria on level A ensure the basic requirements for digital accessibility, those on level AA cover the most frequent and relevant barriers. Where legal regulations exist for digital accessibility, WCAG 2.0 or 2.1 at conformance level AA apply as the de-facto standard. In Switzerland, this is regulated within the framework of the eCH-0059

standard, in the EU by the European standard EN 301 549. The success criteria at level AAA meet the highest accessibility requirements and are usually considered by institutions specialising in communication with people with disabilities.

Conformity with WCAG 2.1 AA means meeting a total of 50 success criteria, 30 at level A and 20 at level AA. Although the success criteria are formulated in such a way that they are relatively easy to verify, the technology-agnostic formulation means that the guidelines themselves allow little concrete guidance for action. Therefore, the actual W3C standard WCAG (W3C WAI 2021a) is embedded in a whole series of other documents and other standards. These include How to Meet WCAG 2 (Quick Reference)[6], Understanding WCAG 2[7], Techniques for WCAG 2[8], the WAI-ARIA Standard[9], the Authoring Tools Accessibility Guidelines (ATAG)[10] or the User Agents Accessibility Guidelines (UAAG)[11].
The driving force behind these standards, guidelines, and specifications, but also a valuable source of inspiration for raising awareness and providing assistance of all kinds in the area of digital accessibility, is undisputedly the Web Accessibility Initiative (WAI)[12], a division within the World Wide Web Consortium (W3C)[13].

Digital accessibility should therefore not be underestimated, neither in scope nor in complexity. However, it is not so much the aspect of accessibility itself that is extensive and complex, but rather the digital-implementation aspect, where the requirements are spread over many shoulders; and not everyone who comes into contact with the topic needs to master all the relevant guidelines and standards.

Accessible higher education teaching

Basically, the same requirements for the digital environment as everywhere else apply to teaching. The focus here is on digital information and communication channels and on technologies for organising studies, for imparting and reflecting on knowledge and applications skills, for exchanging and reflecting on exercises and, finally, for checking what has been learned in the context of performance and skills certificates. This means that the demands on educational institutions are much more comprehensive compared to other institutions, where efforts to achieve accessibility are often limited to external communication in the form of websites or web services.

Digitisation as a prerequisite

As is the case for the topic of accessibility, the availability of information and communication channels in digital form is a prerequisite for accessible teaching in the first place. For people with very severe limitations, for example people with severely limited mobility, this also includes the possibility of completing a large part of their studies online as distance learning. However, this aspect will not be further discussed below, nor will didactic aspects.

Digital interfaces between higher education institutions and students

An important and often underestimated aspect of inclusion and accessibility is the associated independence and self-determination for those affected. However, this can only be achieved through seamless access to all relevant information, services and other interfaces between the university, the department, and the students.

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[6] https://www.w3.org/WAI/WCAG21/quickref/
[7] https://www.w3.org/WAI/WCAG21/Understanding/
[8] https://www.w3.org/WAI/WCAG21/Techniques/
[9] https://www.w3.org/TR/wai-aria/
[10] https://www.w3.org/WAI/standards-guidelines/atag/
[11] https://www.w3.org/WAI/standards-guidelines/uaag/
[12] https://www.w3.org/WAI/
[13] https://www.w3.org/

Organisational aspects of study

Before students can actively and enthusiastically start their studies, they must overcome a multitude of organisational hurdles: study regulations must be studied, course catalogues must be consulted, personal study and timetables must be compiled, lectures and courses must be enrolled into. What are the rules in the individual departments, at the individual chairs, and where do which lectures and courses take place? People with disabilities, e.g., blind people, also want to be able to gather all this important information on their own. A variety of digital applications and information portals are available at ETH for this purpose: the teaching applications and the ETH websites. These are the best prerequisites for the path towards an inclusive university.

Learning materials

Undoubtedly, the most important, but also the most challenging aspect of an accessible study, is seamless access to all relevant learning content. This is demanding because during a study programme or course, an enormous amount of learning content accumulates on the most diverse media and platforms – and this from the most diverse sources and under the most diverse responsibilities.

Textbooks and academic articles

There are the textbooks and academic articles from publishers and authors outside the university itself. The direct influence on the accessibility of this content is of course limited. Often textbooks are not even available in digital form. Scientific articles are also often only passed around as photocopies or as scanned PDF documents. In these cases, it is advisable to prepare the content accessible within the university, if necessary, i.e., at the request of those concerned. For legal aspects see Marrakesh Treaty (WIPO 2013). In the USA, almost every college has an accessibility office where applications can be made. In the medium term, this practice is likely to become established in Europe as well.

Own content, lecture notes and other in-house productions

It is easier to ensure accessible learning materials wherever they are produced in-house and can be made accessible themselves. This means for own academic articles, lecture notes, contents of e-learning platforms, presentation slides, etc., but also for learning videos and lecture video recordings.

The goal of the inclusive university must be to implement as much accessibility as possible when the learning materials are created. Content should not have to be subsequently edited to make it accessible but should always be planned and implemented with accessibility in mind. This requires a gentle cultural change, which can be achieved through awareness raising and suitable, efficient, and practice-oriented training offerings. This includes lecturers, teachers, assistants, and all those who are involved in any way in the production of learning materials. Not every single person involved needs to become an e-accessibility specialist. Often, it is a matter of familiar habits that need minor adjustments, or even just adjustments to software settings, e.g., the PDF-export function of authoring tools such as Office applications. For others, a good introduction to the topic of accessible documents finally provides the convincing arguments to work with format templates. Or a department or chair makes a conscious decision in favour of accessibility to offer all learning materials centrally in HTML format in the future, at ETHZ for example in Moodle or Polybook (see LaWeb on Gitlab). This, in turn, benefits not only people with disabilities, but all students, who no longer need to laboriously search for the various documents and content resources on several platforms. The same applies to semantically well-structured content, which helps everyone, regardless of any special needs, to find their way around the content better and to better integrate the content into existing knowledge.

Accessible learning materials present authors with a few challenges that go beyond the classic requirements for accessibility, especially at the university level. Textbooks, lecture or presentation scripts, for example, often contain highly complex illustrations that depict entire system contexts. Text alternatives for such complex illustrations can only be written by specialists who are appropriately sensitised to the needs of people who depend on them. Further challenges arise from mathematical, chemical, or other subject-specific formulae and symbol languages – however, accessibility of the lingua franca of mathematical typesetting, LaTeX, is provided on all standard learning systems of ETH.

Lecture recordings & teaching videos

Another peculiarity of accessibility in teaching is the high value placed on video material. For many people with disabilities, lecture recordings are not just a nice convenience (in addition to the face-to-face lecture), but the one main source of knowledge transfer. People with hearing disabilities rely on the text transcriptions, e.g., in captions. For people with mobility impairments, lecture recordings and learning videos are often the only way to access certain courses at all. Others simply learn better if they can listen to what their professor has to say several times. Why not in the evening during a jog? The COVID-19 pandemic has shown us in recent months how helpful video recordings of lectures can be.

To ensure accessibility of video footage, some key points need to be considered. Spoken text and relevant audio content must also be available in the form of high-quality text transcripts for students with hearing disabilities. Although there are technical possibilities today to have captions of considerable quality created fully automatically at reasonable prices, their quality is often insufficient in the context of university teaching, where many complex issues are addressed, and specific technical terms are used. Fully automated captions should therefore always be checked for quality by experts and adapted if necessary. Visual content, e.g. complex illustrations or statistical analysis graphics on presentation slides, must be described verbally in such detail that their central content can be understood even if the graphics remain invisible.

E-Learning platforms, collaboration tools and teaching applications

Optimally prepared accessible learning content is of little use if it can only be accessed poorly or not at all by people with disabilities. It is therefore crucial that the technical infrastructure of the university with e-learning and video platforms, collaboration tools, document filing systems or apps and websites itself meets the highest accessibility standards. These are the platforms from where the actual content is downloaded or within which it is consumed directly.

Roughly speaking, two main sources of digital accessibility problems can be identified: editorial and content aspects are generally the responsibility of authors. Aspects of interaction and orientation within applications, on the other hand, are the responsibility of their developer teams, which are typically software companies or IT-teams at universities. This includes navigation concepts, forms, widgets such as overlays or accordions, etc., and feedback concepts. Do all interactive elements also work with screen readers or with keyboard only, are the different areas of views also well distinguishable by screen reader users, etc.? It is also the responsibility of software creators to ensure that authors can create accessible content at all. Can correct heading levels be specifically assigned to headings? Can illustrations be provided with alternative texts? Can tables be provided with table headings?

In universities, the procurement departments for the technical infrastructure are responsible for this. Systems to be purchased must be carefully checked for accessibility and vendors must be held accountable in the event of problems. Furthermore, in terms of accessibility, less is more: it is advisable to concentrate the technical infrastructure on a few high-quality products. This also minimises complications caused by tedious searching for learning content – a hurdle not to be underestimated for all students, but a high hurdle for people with disabilities.

Software

Universities not only impart pure knowledge, but increasingly also application skills. Especially in higher education, these are often connected with the use of special software and user interfaces of special devices. We would like to urge the responsible bodies to take accessibility aspects into account when procuring or developing their own software.

E-Assessment / Distance Testing / Online Testing

Teaching does not end with the imparting of knowledge and competences, but also centrally involves the regular and final verification and assurance of what has been learned within the framework of performance and competence assessments. Quite independently of special needs and disabilities, complex regulatory and technical challenges arise where examinations take place on computers, e.g., because application competences in programming or computer-based statistical analysis want to be measured. People with disabilities are often fundamentally dependent on the possibility of computer-based examinations; paper-and-pencil exams are not possible for many people with disabilities. What is needed, therefore, are possibilities and approaches for conducting examinations in a computer-based, secure, legally watertight, and accessible manner.

Institutional aspects of accessible teaching

Under "Digital interfaces between higher education institutions and students" in the previous section, it was shown where possible problems of digital access might exist. Teaching, as its central element, is closely linked to practically all areas of a higher education institution. Involved are the areas of central infrastructure and IT, areas of university communication, the library, student services and especially the departments and chairs where the actual teaching is taking place.

In this environment, developing a strategy to ensure the accessibility of teaching presents all universities with challenges that must not be underestimated. The greatest challenge is to ensure the accessibility of teaching across the board, while at the same time leaving the freedom of the departments and chairs as untouched as possible.

Motivation and awareness building

All parties involved in the selection, procurement and production of teaching materials must be convinced of the goal of accessible teaching and intrinsically motivated to make their respective contributions. A gentle but profound cultural change is desired, whereby accessibility and inclusivity become a matter of course and an everyday normality at the university; without the active commitment of everyone, inclusive teaching remains wishful thinking. People should develop an interest and curiosity in the topic through good awareness campaigns. They should be informed transparently at an early stage what planned measures mean for each individual person, and it must be ensured that they receive the necessary support in all areas.

Nevertheless, it will not hurt any university to explicitly incorporate accessibility in its development strategy, and to have this goal strongly supported and promoted by the university executive board.

Knowledge and competence building

A comprehensive range of support services and training requires the availability of relevant knowledge and application skills within the university. At ETH Zurich, the information platform on accessible teaching (Bolfing 2021a) offers a comprehensive selection of good online tutorials and resources under the heading Resources. Currently, several promising initiatives

are emerging to promote inclusive higher education in Switzerland, which aim to make this knowledge and the corresponding application skills available to a wider public.

The aim of training is to enable all stakeholders. It is important that the right know-how and competences are built up specifically where they are needed. Authors do not need training in accessible web development, but they do need to know how to use their authoring tools correctly to create accessible content, how to structure content semantically correctly and what to look for when writing alternative texts. Procurement managers need to know how contracts must be tendered, that contractors and suppliers can be held to the assured accessibility of their products. Within most individual areas of responsibility, the key accessibility requirements are usually easy to learn. And, once they are learned, they hardly cause any significant additional effort.

Accessibility offices

Awareness-raising and information campaigns, support, and training services, as well as the interaction of the many stakeholders, certainly need to be coordinated. As explained under "Learning materials", accessible teaching concerns not only the departments but also the central digital infrastructure for e-learning, information and video platforms, and other relevant teaching applications, including, for example, the university's library or student services.

In the USA, where digital accessibility in education is widespread and established, university departments have proven themselves to be able to carry out this organisational coordination effort. Today, practically every educational institution there has an accessibility office, which, in addition to assisting students with disabilities, also supports and trains faculty members. Where still necessary, these offices initiate the cultural change. They develop visible strategies and policies, such as an HTML-first strategy, when it comes to making content available in the most suitable format for digital accessibility. They develop concepts for the necessary knowledge development and retention. For example, when uploading video and audio files to media or e-learning platforms, they can link directly to automatic text transcription services, so that all uploaded videos and audio files are automatically added with closed caption or text transcripts respectively. If higher quality text transcriptions are needed, it is their specialised service that can handle such orders. Specialised agencies advise on new challenges and develop new solutions to new problems.

Accessibility offices are contact points for people with disabilities and offer short-term ad-hoc support with various problems concerning access to digital content.

Conclusions: accessibility as a process

From what has been said so far, it should be clear that the state of accessibility at a university cannot simply be decreed, but that accessibility is a constant process of improvement and optimisation.

Once this process has been initiated, it is the new, talented, and innovative students themselves who help to improve the quality of accessibility with their concerns and suggestions for solutions. We look forward to this day.

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Diversity-sensitive degree programme development – personalisation of learning: Modern teaching and learning concepts in a Swiss context

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Abstract

In the framework of the swissuniversities P7 funding programme "Diversity, Inclusion and Equity" (2021-2024)[6] the University of Teacher Education Lucerne and ETH Zurich are conducting a collaborative project entitled "Diversity-sensitive degree programme development – personalisation of learning". The objectives of this project are to analyse current discourse and concepts surrounding diversity and personalisation, to explore the challenges which degree programs encounter at both institutions in this context. The project seeks to further the conceptual development of degree programmes in the area of diversity and aims – in close cooperation with degree programme managers – to underpin the concrete realisation of associated measures in diversity-sensitive, personalised study programmes.

Diversity as a didactic challenge

A higher education system, oriented simultaneously towards diversification and openness, attracts increasingly students of varied backgrounds, qualifications and expectations. In this context a productive approach to diversity is becoming the norm, but remains also an ongoing didactic challenge – at all levels of teaching, course design and degree programme development. Diversity-sensitive programme development draws on the concept of a curriculum (qualification profile, range of courses, examinations etc.) which takes into account student diversity not only in terms of previous knowledge, preferred modes of study, interests etc, but also in terms of gender, nationality, age, background, religion, social status or physical, mental or psychological (dis-)ability (SBFI n.d.). Diversity-sensitive programmes are designed so that according to their resources and potential, students will be offered various learning paths and opportunities, adequate support and funding possibilities. The aim is to ensure

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[6] For an overview of the aims of the swissuniversities project "Diversität, Inklusion und Chancengerechtigkeit in der Hochschulentwicklung" see: https://www.swissuniversities.ch/themen/chancengleichheit-diversity/p-7-diversitaet-inklusion-und-chancengerechtigkeit (swissuniversities n.d.)

equality of opportunity for all student groups and to optimise the chances of academic success for those previously under-represented. If diversity is considered to be the new norm, then the format and content of courses, and the learning culture of programmes, have to be reflected upon and revised accordingly. Specific disciplines and their associated competences must also be scrutinised (Auferkorte-Michaelis & Linde 2017).

The requirement for "more diversity" critically questions the traditional self-image of educational institutions at the tertiary level. A process of reflecting upon and, possibly, changing institutional norms and forms of inclusion and exclusion necessarily follows. To empower previously under-represented groups towards academic success, untapped potential must be recognised and acknowledged. It follows also that concepts such as excellence and innovation require redefinition in the sense of achieving excellence through diversity.

Individuals – according to strategic goals of Swiss education policy – should be able to achieve their full potential irrespective of gender, nationality, age, origins, religion, social status, or physical, mental or psychological disability (SBFI n.d.). In practice, this goes hand in hand with the call to "open up universities" and the acknowledgement of existing forms of direct and indirect discrimination. Overcoming this discrimination requires action in the areas of the culture, practices and structures of the higher education landscape.

Is personalised learning the answer?

The growing reference to "diversity" (which generates "diversity policies", "diversity management", "diversity tools", diversity officers etc.) reflects institutions' growing consciousness that students of very different backgrounds are arriving at university. Diversity contains two different aspects: On the one hand, it addresses issues of variety of experiences, cultures, traditions and ideas, which are to be maintained and nurtured as a resource for innovation and excellence. On the other hand, it addresses questions of inequality, which have to be countered and overcome in order to achieve equal opportunities for all. In this spirit, concepts of "personalisation", "individualisation", "customisation" and "flexibility" in learning can be understood as ways to address student diversity in order to achieve a new fit between students and courses on offer in the context of diversity.

Personalisation, however, is a fuzzy concept, and the term is applied in all kinds of different contexts: there is personalised medicine, personalised advertising, and there are personalised children's books. In didactics, various differing concepts and methods are mixed under the term personalised learning. For example, under this umbrella, we find listed: profile-based student-centred teaching, developing future skills, methods to meet the requirements of flexible career paths and more. Personalized learning methods may also take their rationale from active learning methods and deep learning approaches.

While diversity and personalised learning are somehow linked, their discursive roots are, however, different, and the underlying contexts and perspective of reasoning diverge widely. For example, "personalisation" is frequently taken to mean designing an exact fit for the "client", putting the individual in the centre. The concept of "diversity" instead, critically targets normative views of "typical" students and calls for the design of degree programmes, which foster the maximum achievement in a wide range of different people and social groups. In the discussion about diversity, personalised learning, customisation, or flexible learning, universities are furthermore confronted with many different demands and challenges: the search for the best minds; competition for students in the increasingly open education market; ever-more-diverse life choices and careers of lifelong learning. Although personalised learning seems to be an approach to answer various challenges that universities face in the context of diversity, there are still many questions regarding the significance and impact of the concepts as well as their implementation.

The project

Over the last few decades universities have mainly focused on gender and equal opportunities for women. This is reflected in university structures (gender officers, equal opportunity committees) and academic support (mentoring, career advice, MINT etc). Another focus on "internationalisation", has also been apparent, reflected by the establishment of "international offices" at universities and/or university courses delivered in English. As universities continue to open up, the spotlight is increasingly on further non-traditional student groups: Migrants, Refugees, People of non-academic background, of low social or economic status as well as persons with diverse (dis-)abilities, impairment and chronic illness, of diverse sexual orientation and gender identities. This "opening up" in the understanding of diversity is evidenced not only in State Secretariat for Education, Research and Innovation (SERI) programmes such as the swissuniversities P7 funding programme "Diversity, Inclusion and Equity, but also in the fact that former "gender officers" are now frequently known as "diversity officers" (regardless of the fact that equality for women at universities is far from being achieved).

By linking diversity and personalisation, and focusing on degree programme development, the dual-university project aims to make an application-oriented contribution to educational development. It will investigate how far concepts of diversity-sensitive programme development are compatible with the underlying concepts of personalisation and individualisation. The goal here is firstly to build a bridge between the university didactics conversation and the current targets of education policy, and secondly to systematically link the widely separate discussions of diversity awareness and personalisation.

Criteria will be identified and compiled, which can be deployed to analyse existing degree programmes. In close cooperation with persons responsible for degree programmes, research findings will be integrated directly into ongoing practice. A theory-based critical scrutiny will be informed by including experts from the fields of university teaching and degree programme development. In 2022, for example, a multi-part series of events on diversity and personalisation in higher education will be organized, to foster exchange and discussion of concepts surrounding diversity-sensitive, personalised degree programmes. These events will be public, and members of both ETH Zurich and the University of Teacher Education Lucerne will receive special invitations. The project will potentially reveal the two universities' different approaches to developing and implementing diversity-sensitive, personalised degree programmes. These approaches will inform the practice-oriented recommendations which will be made available to other universities.

Even though the topics of diversity, inclusion, equity and/or equal opportunity have finally arrived in Swiss universities, it is clear that concrete efforts will still be needed to ensure that the principles underlying educational policy are translated into standard practice in curriculum and degree programme development.

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