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Bulletin

Das Doktorat: Anleitung – Betreuung – Verantwortung
Le doctorat: Direction – encadrement – responsabilité

Mit Beiträgen von

Romain Jacob
Colette Hänggi-Niclasse
Jürg Fröhlich
Antoinette Weibel
David Dunand
Ursula Keller and Anna Garry
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ETH zürich

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Editorial

Gernot Kostorz

Liebe Leserin, lieber Leser

Die Berechtigung, in allen Bildungsfragen mitzureden und zu urteilen ist niemandem abzusprechen – auch wenn manches über den eigenen Horizont geht, weil der aktuelle Einblick fehlt. So wird in regelmässigen Abständen die (zumindest Zürcher) Öffentlichkeit von den Medien mit Berichten und Kommentaren über vermeintliche oder tatsächliche Probleme und Skandale auch im Bereich der tertiären Bildung versorgt. In letzter Zeit galt die Empörung dem Umgang von Betreuenden mit ihren Doktorierenden, einem Bereich, von dessen heutigen realen Verhältnissen wohl nur wenige der darin nicht täglich Geforderten mehr als schwache Kenntnisse besitzen. Was von den Berichten bleibt, ist der wohl gewünschte Eindruck, vermeintlich Privilegierte (Leiter und Leiterinnen von Doktorarbeiten, d.h. hinsichtlich der Verantwortung ganz überwiegend Professorinnen und Professoren) übten anhand ihrer Machtstellung perfiden Missbrauch. Mobbing, überzogene Ansprüche an die Leistungsbereitschaft, schlechte Bezahlung und andere Benachteiligungen seien für einen grossen Teil der Doktorierenden zu beklagen.

Wenn man zahlreiche Doktorierende bei ihren ersten wissenschaftlichen Gehversuchen unterstützt hat und auch ihre weiteren Wege in den meisten Fällen noch lange begleiten durfte, schmerzen diese als symptomatisch dargestellten Verallgemeinerungen. Eine der letzten verbleibenden «Bastionen des Machtmissbrauchs» – und das noch im öffentlichen Bereich – gilt es wohl zu brandmarken. Gute Absichten sind dabei nicht klar erkennbar.

Das vorliegende Heft entstand in der Absicht, zu einer Versachlichung und konstruktiven Entwicklung der Diskussion beizutragen. Auslöser der neuesten Empörungswelle war ein Bericht vom Herbst 2017 zu einer Umfrage der Akademischen Vereinigung des Mittelbaus an der ETH Zürich (AVETH) zur Doktorierendenbetreuung. Romain Jacob, Mitautor des Berichts, beleuchtet in seinem Beitrag zur Eröffnung in sachlichem Ton die erkennbaren Problemzonen, erinnert aber an die korrekten Massstäbe. Colette Hänggi-Niclasse berichtet über Ergebnisse ihrer Studie zum selben Thema, aber mit anderen Mitteln, in Fribourg.

Ein Lamento über Mängel war jedoch weder für diese beiden Autoren noch für die folgenden das Ziel, sondern die Vermittlung eines Bildes über heutige Vorstellungen zum Doktorieren.

In den meisten Fällen wird man zum Doktorat nicht mehr, wie in den Frühzeiten der akademischen Studien, mit eigenen Mitteln an eine Hochschule pilgern, um den Koryphäen zu Füssen zu liegen, und für die erstrebte Anleitung zur selbstständigen wissenschaftlichen Arbeit bereit sein, alle möglichen Dienstleistungen zu erbringen. Bezahlte Anstellungen und Stipendien helfen heute, dass die materiellen Umstände während der Zeit des Doktorierens nicht zur Hauptsorge werden. (Doktorieren kann aber nicht als Beruf im herkömmlichen Sinne gelten! Das übliche Palaver über «Work-Life Balance» macht hier wenig Sinn, denn geistige Arbeit schliesst private intellektuelle Beschäftigung ein und setzt persönliches Interesse voraus.) Für die materielle Unterstützung muss man auch bereit sein, einen Teil seiner Zeit und seiner Begabungen dem akademischen Umfeld zur Verfügung zu stellen. Die Balance zwischen den auferlegten Pflichten und der eigenen Arbeit mit dem Ziel der intellektuellen Verselbständigung zu finden, ist wohl das Kernproblem.

Die Sicht der Betreuenden wird in Jürg Fröhlichs Beitrag und in einem Kurzinterview mit Antoinette Weibel beleuchtet. David Dunand, der Schweiz verbunden, berichtet, wie man an einem US-Departement Doktorierende auswählt und betreut, Ursula Keller und Anna Garry schildern neue Ansätze zum teambasierten «Training» von Doktorierenden, Andrea Rögner beschreibt, wie die digitale Bildung im Doktoratsstudium zur Betreuung beitragen kann. Schliesslich stellt Helke Hillebrand eine systematische Analyse und normative Komponenten einer zeitgemässen Doktorierendenbetreuung vor.

Die grosse Zahl der Kolleginnen und Kollegen, denen der Redaktor auf seinem langen Lebensweg begegnet ist, haben fast ausnahmslos ihre grösste Freude und Genugtuung darin gesehen und gefunden, Talenten der jüngeren Generationen den Weg zu ebnen. Problemfälle haben immer eine sehr individuelle Geschichte, Machtmissbrauch ist ein extrem seltenes «Werkzeug» und führt für niemanden zu erfreulichen Ergebnissen. Möglicherweise haben diese Einsicht (noch) nicht alle gewinnen können, die mit der Betreuung von Doktorierenden ja nicht nur «forschen lassen», sondern auch vorleben sollten, wie man forscht – heute immer mehr im Team.

Auch unter Hochschuldozierenden sind die erforderlichen Tugenden zur Berufsausübung nicht gleichverteilt, und es gibt hier und da sicherlich Betreuungsdefizite bei Doktorierenden. Wie bei allen Menschen geht vieles auch bei Doktorierenden nicht ohne Zuwendung und Wertschätzung. Deshalb ist es wahrscheinlich sehr hilfreich, wenn man die Integration und Betreuung des wissenschaftlichen Nachwuchses auf eine breitere Basis stellt. Die Begründung einer Zusammenarbeit und die abschliessende Verantwortung sollte jedoch den Urhebern der Forschungsthemen zustehen.

Eine anregende Lektüre wünscht Ihnen
Ihr Gernot Kostorz

Challenges and opportunities in doctoral supervision – a student's perspective

Romain Jacob*

Doctoral Supervision has recently attracted a lot of attention in the Swiss media after the breakout of the story of the former Institute of Astronomy at ETH Zürich, in Fall 2017. As one of the authors of a survey on Doctoral Supervision conducted by AVETH (Academic Association of Scientific Staff at ETH Zürich), I was given the opportunity to share my views on the topic.

I must clarify that the views I present here are my own [being myself a third-year doctoral student, enrolled with D-ITET (Department of Information Technology and Electrical Engineering, ETH Zürich)], and not coordinated with, and thus may not reflect those of AVETH or ETH Zürich.

1. About the AVETH supervision survey

After the public release of the AVETH Supervision Survey report[1], Swiss and international media ran stories using some of our findings... with various levels of honesty. Multiple headlines read something close to: "a quarter of doctoral students at the ETH Zürich experience abuse of power from their supervisor". This is a misleading summary of what we reported and I want to correct this.

Overall, 24% of the survey respondents indicated that they experience some kind of abuse of power, but:

- This count includes very diverse things, ranging from harassment to lack of scientific freedom (the complete numbers and answers are shown in Fig. 1).
- This completely neglects the response rate of the survey (37%). Although this cannot be verified, one can reasonably believe that such survey has a natural bias towards 'the most unhappy people', which are more keen to answer this kind of polls.

This is not to say that there is no problem, but saying that "a quarter of doctoral students at ETH Zürich experience abuse of power" is a misrepresentation of the available data. Moreover, the case of ETH should not overshadow the situation. Unfortunately, I do not believe that abusive supervisors are a problem limited to ETH.

Following our efforts, multiple university representatives from Switzerland are now running (or planning) surveys similar to the one we conducted. It will be very interesting to see what their findings are... assuming that their results are also made public.

Finally, it must be said that the large majority of professors are doing a great job, as also shown by our survey results: 62% of doctoral students at ETH are satisfied with their supervision (40% very satisfied).

2. About doctoral training

Before delving into my views on what makes doctoral supervision challenging, and how we could (try to) improve it, it might be worth reflecting on the doctoral training itself. The number of people getting a doctorate has increased enormously in the past decade, both in absolute numbers and in percentages. But does this make sense? Should we keep pushing in that direction? Or should we give up on doctoral training completely?

I think everyone would agree with at least one thing: The landscape of higher education has significantly changed in the past few decades, including doctoral training. A doctorate used to be the entry point of an academic career. Today, we train many more people for a doctorate than there are available positions in academia. This came to be for at least two reasons:

- The general level of education in new generations has increased, at all the levels; high school, bachelor, master, and eventually doctorate.

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Romain Jacob is Doctoral Student and Research Assistant at the ETH Zürich since 2015, focusing on low-power wireless communication and networks. Born and raised in France, he studied Mechanical Engineering at the École Normale Supérieure de Cachan (now ENS Paris-Saclay). There, he passed the Agrégation (a French teaching accreditation for higher education) in Mechanical Engineering in 2013, followed by a one-year stay at UC Berkeley as junior researcher, then moved to Zürich for his doctorate.
Beside research, Romain Jacob has been involved in university politics both at ENS Cachan and ETH Zürich. As representative of the scientific staff, he led the Politics Team of AVETH for one year and coordinated the work on the AVETH Doctoral Supervision survey, in 2017–2018.

[1] *https://www.research-collection.ethz.ch/handle/20.500.11850/262661/* (8 October 2018)

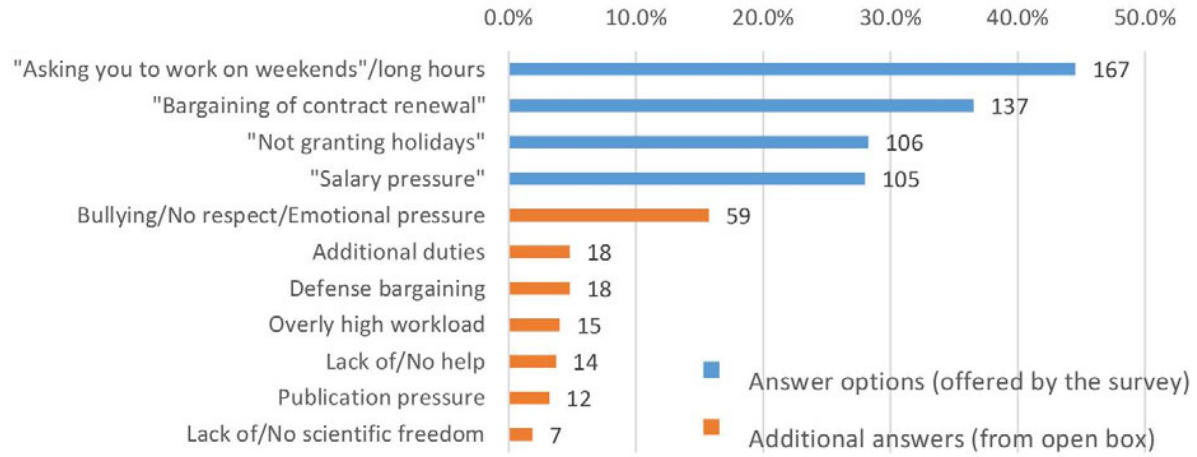

Figure 1. *The original figures related to abuse of power from the AVETH Survey on Supervision of Doctoral Students (based on 1'594 completed survey answers, corresponding to a response rate of ~37%).*

– The doctoral students are those 'doing the research' at university. The more doctoral students, the more research can be conducted.

That being said, I think the doctoral training is indeed valuable beyond academia. In fact, doctorate is a lot about independent learning, critical thinking, problem solving, analyzing a situation, and deriving a strategy towards a solution; and in my opinion, this is at least as important as the scientific expertise. The time when people would do the same job for 40 years has passed. Things simply change too fast. Society needs more and more people who have the agility required to adapt to these changes, and I think the doctoral training is an important piece of the puzzle. Actually, holding a doctorate is already being more and more recognized as an asset in industry.

In summary, I believe the doctoral training is indeed extremely valuable, and it is a worthwhile effort to make it even better.

3. The challenges in doctoral supervision

To argue about potential means of improvements, we must ask ourselves the following questions: What makes doctoral supervision difficult? Why are doctoral studies so peculiar?

First of all, the most obvious challenge in doctoral supervision is the double status of the doctoral students; both in training for a degree, and employed as research assistants. As such, a doctorate is not like any other job; there is the end goal to graduate. For somebody who wants to pursue an academic career, there is hardly a second chance. The doctoral project must work out, or one will be too old to be competitive for tenured positions. This creates a lot of pressure for doctoral students and might lead them to put up with more than what young professionals in industry would ever be willing to accept. Conversely, professors are simultaneously employers, supervisors, and examiners of the thesis; a great deal of power for a single pair of hands.

To be fair, professors and university group leaders also have a difficult job. Beside their scientific expertise, they must be good lecturers, good mentors, fund raisers for their research (where competition is fiercer than ever), and managers of their group; without mentioning the beloved administrative duties. It is rare to find such a diverse set of skills in one person. Even prestigious universities like ETH have difficulties finding such people. In the hiring process, the mentoring and management skills are often neglected, or at least considered not as important as research productivity.

Being a doctoral student is a wonderful but difficult job that requires above-average commitment to one's work; it is much longer than other projects one takes on as a student. Plus, it is endless. One can always go further or dig deeper. A senior doctoral student I once met summarized this problem in one sentence: "in a PhD, you can never say 'This is done', but only 'I am done with this.'" In such context, it is objectively hard to differentiate self-indulged long working hours (out of personal motivation) from the unreasonable pressure of a supervisor.

In addition, the doctoral studies are often the first "professional experience". Most doctoral students have spent their whole life at university. As students, they were used to follow the orders of professors; thus as employees, they tend to lack critical thinking on what they should tolerate.

Furthermore, doctoral studies are difficult to regulate by nature, because of the many forms they can take. First of all, because good supervision is not (and should not be) a well-defined recipe. People are dif-

ferent, and ultimately successful doctoral supervision strongly depends on a good match between supervisor and student. Moreover, there are differences in the scientific fields. For example, external expertise work (on topics unrelated to one's thesis) are common place in some engineering fields like civil engineering, but completely unheard of in others. Finally, there are cultural differences; for example, people from different cultural backgrounds may have very different perspectives on authority. This cultural variety is continuously growing as both students and professors are coming from all around the world.

In this international context, universities are competing to attract the best talents; reputation is of prime importance, bad press is dreaded, and problems are concealed. Thus, it is not surprising to see that universities try to deal silently with serious issues, like harassment from professors. As we say in French: "On lave son linge sale en famille", i.e., dirty stories should remain private.

But handling problematic individuals privately does not solve the issue. When cases of abuse of power are undeniable, the involved professors quit their position quietly rather than resist and eventually see their mischief publicly exposed. Thus the tyrannical professor is gone and the university's reputation is preserved; so everything is well? Not quite. This same professor is still a leader in his or her field and he or she is likely to get hired somewhere else, where the story is likely to repeat itself. This has happened in the past, happened again recently, and unfortunately will most likely keep on happening. The problem is that the right thing to do from a moral stand point (i.e., publicly exposing abusing individuals) can seriously damage the university's reputation; arguably a real dilemma for university leaders.

Finally, academia offers high job stability through tenured positions (or some equivalents). This was originally thought to protect researchers and let them explore 'crazy ideas', push them to be innovative, go outside the beaten path; without having to worry too much about succeeding to keep their job. And that is great!

Unfortunately, there is another side to the same coin: professors have such safe positions that it is legally difficult, in many countries, to do anything against a professor who reveals being a poor group leader or manager.

4. Making a change

Improving doctoral supervision is an important but challenging task for all the reasons I mentioned above, and probably others. Some practices must disappear; some would be worth spreading. I discuss here a handful of ideas that I find the most interesting.

4.1. Abolish the practice of fake part-time

I mentioned earlier the above-average job-commitment of doctoral students. Such commitment calls for the respect and support from universities and employers. Fake part-time contracts are the opposite of that: It is a common practice in some Swiss universities that doctoral students are employed with a 60% work contract, in a wicked manipulation to lower the salaries. Beyond the disputable morality of such practice, this also has serious consequences regarding the social rights of the employee. Needless to say, most doctoral students actually work more than the 41h/week of a full-time job, often much more.

This practice of fake part-time employment is disappearing at ETH (the new salary system – 100% employment by default – came into force in 2015). Let us abolish fake part-time completely.

4.2. Accept to spend some money

If universities are really serious about improving the quality of doctoral supervision, they must accept to dedicate some money for it. There is work to be done: For example, it would be important to seriously investigate academic productivity. What makes a good research team? What conditions must be fulfilled to maximize its productivity?

Chances are that the findings would be similar to the ones from "re:Work", a project from Google that strives to "make [Google's employee] happier, healthier, and more productive"[2]. They found for example that the premise of everything is psychological safety; "far and away the most important of the five dynamics we found".

The recent ETH+ initiative[3] would be the perfect opportunity to start an ambitious project on doctoral supervision at ETH Zürich. Members of AVETH submitted a proposal in that direction, but it was not selected in the first round of financed projects. Let us hope that ETH will reconsider and seize the opportunity in the second round of ETH+.

4.3. Prevent conflict

Assuming that indeed, the psychological safety is the most important criterion for academic productivity,

2 *https://rework.withgoogle.com/blog/five-keys-to-a-successful-google-team/* (6 October 2018)

3 *https://www.ethz.ch/en/the-eth-zurich/portrait/Strategy/ethplus_en.html/* (6 October 2018)

much effort should be spent on preventing conflicts. And I really mean 'prevent', not mediate or mitigate; organize teams such that personal conflicts do not happen in the first place.

That may sound like wishful thinking, but there are actually some interesting ideas that can make that possible. Social sciences have shown that conflicts most often stem from divergence in the core values of individuals. In other words, we can avoid conflicts by better matching doctoral students and supervisors. That is the underlying idea of a project called "Matchademics". Similar to a love matching service, a set of carefully crafted questions allow both students and supervisors to get an overview on each other's values, before starting the doctorate; thus avoiding later-revealed personality clashes.

To date, there has not been any large-scale pilot experiment of "Matchademics", which would be very interesting. Similar approaches are successfully used in the private sector; there is a priori no reason it cannot work for academia as well.

4.4. Include lecturing and mentoring as part of the career advancement

In many countries, the career evolution of professors and researchers mostly depends on their research track record. Little emphasis is put on their lecturing and mentoring skills. I think that should change. Young assistant professors are rarely trained as group leaders, while this is a core competence needed for the job. Management training should be systematic and compulsory.

Furthermore, universities should value more these leadership skills, and promote exemplary leaders. Precisely for this purpose, AVETH and the ETH Zürich recently co-created the ALEA Award (Art of Leadership)[4].

4.5. Be more selective in the hiring process

As I mentioned earlier, professorships tend to be very safe and stable positions. I think this should remain that way, but I also think universities should be more demanding on the candidates. As discussed above, it is not just about research, but also lecturing, mentoring, and managing.

Furthermore, even if training and courses for newly appointed professors are important, they are not the answer to everything. They can help people to improve if they are willing to; a person that believes lecturing is a waste of time will not become any better with pedagogy training. The core values of people do not change.

Thus, I think it is important that both graduate and undergraduate students are systematically involved in the hiring process of professors. Naturally, they are not the best judges of the scientific expertise of one candidate, but they are directly concerned by his or her pedagogical skills. Experience has shown cases of undergraduate students who got in touch with students from a candidate's previous university to discuss his or her lecturing performance; and this made a difference in the hiring decision.

4.6. Generalize the doctoral schools

Doctoral schools are becoming more common around the world. Among other things, they can help to limit the problem of over-pressuring supervisors, as they are a third party that both makes and enforces the rules. Yearly committee meetings, retreats, seminars, progress reports: all this represents organizational overhead for universities and additional work for the students. Yet, all the students I met that are (or used to be) enrolled somewhere with strong doctoral schools find it beneficial. Yes, the overhead of preparing and presenting a progress report is significant, but that is work that ultimately pays off.

4.7. Assess the doctoral supervision quality

It is a common practice that, at the end of the semester, students evaluate the lectures they took. But I am not aware of any place where the doctoral students are asked to evaluate the supervision they received during their doctoral studies. Why not? Without going as far as 'evaluation', I think it would be interesting to normalize the exchange of feedback between doctoral students and supervisors.

4.8. Discuss the limits of peer management

In most countries I know, managing positions at university (head of department/faculty, director of studies, etc.) are held by professors. On the one hand, this is good because they know best what their fellow professors need in order to work in the best conditions. On the other hand, these professors are essentially managing their peers, which can cause authority issues.

This may become even more problematic when professors are assuming the responsibility as a duty, for a couple of years, before resuming their position of a 'simple' professor. In this context, it is definitely a complex task to handle a colleague that is abusing her/his power over her/his employees.

[4] *https://www.ethz.ch/services/en/employment-and-work/working-senvironment/family/alea-award.html/* (6 October 2018)

So maybe that should not be. Maybe managing university positions should be given to non-professors, that would stay in charge for longer periods, and effectively detain some authority.

5. About ETH Zürich

In this article, I have discussed many challenges of doctoral supervision and formulated some criticisms, often taking ETH Zürich as an example. This could be (wrongly) interpreted as a criticism of ETH itself. It is not. I mentioned ETH a lot, simply because that is the environment I know best.

To be absolutely clear: I honestly think ETH Zürich is a great place to study and to work. It is considered one of the best universities in the world, and that is for good reasons. The support you get and the opportunities available are excellent. Maybe more importantly, there is the awareness that, to remain one of the best, one needs to act, to adapt, and to improve; continuously. And ETH is doing precisely that. The regulations for doctoral studies are currently being revised, through a global and cooperative process that includes all the university actors, and driven by the honest will to improve the current situation.

If I could do it again, I would still come to ETH for my doctorate; and I would advise anyone to do the same. Of course, there are some issues and aspects on which ETH can improve; but we are working on it! ■

Doctoral students' well-being – an imperative on the path to accomplishment

Colette Niclasse-Haenggi*

Abstract

A doctoral journey is an emotional rollercoaster alternating elation, contentment, relief, hope, interest, with stress, anxiety and frustration. Students who embark on this adventure enrich themselves personally and professionally. However, they are also more likely than others to give up or develop mental health problems. The aim of our longitudinal mixed-method research is to investigate significant emotional events experienced by doctoral students from a medium-sized Swiss university, and to understand what affects their well-being, and since well-being is a decisive factor of accomplishment, to identify which needs must be met to ensure it. 191 events were content analyzed according to the Self-Determination Theory (Deci & Ryan, 2000). We considered three basic psychological needs and the way they were supported or constrained by environment. Standing out, and in line with previous findings, were the feeling of progression and mastery (competence), the importance of a trusted proximal network (relatedness), and the possibility to act with volition and self-endorsement (autonomy). Recommendations for people interacting with or supervising doctoral students are suggested.

1. Introduction

In recent years, the health of doctoral students has emerged as a significant issue in Europe and around the world. The findings give cause for concern: approximately 40–50% of doctoral students experience psychological distress and 30–40% may develop psychological disorders such as depression (Evans, Bira, Gastelum, Weiss, & Vanderford, 2018; Levecque, Anseel, De Beuckelaer, Van der Heyden, & Gisle, 2017). However, as stated by the World Health Organization, health is "a state of complete physical, mental and social well-being and not merely the absence of disease". This issue adds to the older and still thorny matter of dropouts, between 30% and 60% depending on the field of study (Bourdages, 2001; McAlpine & Norton, 2006).

Studies on doctoral students' health and well-being are recent and scarce. Interesting (mostly negative) affective aspects of their journey (steady presence of risky emotions like stress and anxiety, emotional rollercoaster, etc.) emerge but quite often merely as adjunct results.

By contrast, the question of doctoral completion has already given rise to a great deal of predictive and descriptive research focusing on factors differencing completers from quitters, mostly in retrospective approaches. The results are rather contradictory regarding individual and sociodemographic variables (e.g. motivation, gender, age, financial resources, school path, etc.) and contextual variables (e.g. institutional demands, supervision modes, programs, etc.). Reasons for dropouts are multiple, interconnected and complex. The findings reveal a broad dissatisfaction rather than a particular or predominant cause (Bourdages, 2001). A crucial point seems to be the representations the students construct throughout their doctoral journey, which will arouse dynamics of (dis)engagement (Frenay & Romainville, 2013).

In an extensive review, McAlpine, Paulson, Gonsalves, and Jazvac-Martek (2012) emphasize that the students themselves are often seen as the source of the difficulties rather than the academic context. They synthetize interesting results of contrasting research that show for example that supervisors have difficulty giving examples of personal issues students might experience, but mention observing cues related to student's work, that when difficulties arise students tend to ascribe them to personal issues (but are reluctant to talk about it for fear of not matching up), and that the proximal network is critical as a source of support or constraint.

Only few researches provide a sound and comprehensive theoretical frame to investigate those occurrences together and in their complexity (Devos et al., 2016; Van der Linden et al., 2018). The Self-Determination Theory (Deci & Ryan, 2000) is a promising integrative way of doing it. This broad framework is a powerful means to understanding the conditions enhancing or undermining human capacities for psychological growth,

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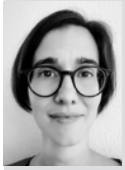

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well-being, and engagement. This theory focuses on how social-contextual factors support an individual's thriving through the satisfaction of three basic psychological needs: autonomy (e.g. self-regulation, volition, self-endorsement), competence (e.g. mastery and effectance in one's interactions with the social environment), and relatedness (e.g. feeling connected and involved, sense of belonging, Ryan & Deci, 2017).

The support provided by the social context, including the supervisor, can nurture elements that help satisfy those needs, namely autonomy support (e.g. offering opportunities to choose directions, encouraging initiative and reflection, linking activities to values, goals and needs), structure (e.g. informational constructive feedback, in-depth discussions, offer expertise, devoting time), and involvement (e.g. concern and interest for the person, availability, reassurance). Some practices, in contrast, thwart the needs: control (e.g. time pressure, overt or covert control over directions or daily activities), chaos (e.g. lack of or negative feedback, contradictory demands, unreachable goals), and rejection (e.g. neglect, remoteness, hostile behaviors) (Devos et al., 2015; Van der Linden et al., 2018). More than 30 years of laboratory and field research, especially in the educational area, evidence the effects of need satisfaction and support (and their thwarting counterparts) on psychological integrity and well-being, the way it affects motivation, interest, creativity, learning (incl. internalization of social norms and practices), persistence, and performance (Ryan & Deci, 2017), all of them being decisive elements of doctoral students' journey and their work as researchers afterwards.

European projects and their follow-ups such as "Research on PhD (RoPe)" in Belgium (e.g. Devos et al., 2016; Van der Linden et al., 2018) and national research project on PhD education in Finland (e.g. Vekkaila, Pyhältö, & Lonka, 2013), as well as studies in the field of health (e.g. Weinstein & Ryan, 2011), show that competence, namely perceiving oneself as knowledgeable and skilled, as moving forward and progressing, as meeting challenges successfully, is a decisive key for persistence and well-being (e.g. experiencing less stress). Autonomy and its support tend to stand out more prominently when thwarted as when satisfied in students' narratives, but not in quantitative studies. Being subject to controlling practices can lead individuals to experience high levels of frustration and anxiety. Anxiety is particularly triggered by contexts featuring competition, comparison, and evaluative practices (which are ubiquitous in academic settings). Experiences of relatedness and involvement are a salient element of narratives, largely concerning the supervisor. Practices of structure also emerge notably, often together with involvement. Finally, Van der Linden et al. (2018) demonstrate that the effects of need satisfaction and support on engagement appear mainly through the emotional dimension. This is in line with the Belgian and Finnish results, showing that emotional equanimity (e.g. not too much distress and less intense unpleasant emotions) implies more perseverance and/or engagement.

This is enlightening if we consider the functionality of emotions: a social system of signaling, allowing flexibility of behavior (Sander & Scherer, 2009b). Emotions are signs that something important is happening in relation e.g. to the needs, motives, values and beliefs of the individual, and that the event may require adaptative action or internal adjustment (Scherer, 2001). Emotions are also indicators of subjective well-being (Sander & Scherer, 2009a). They are thus a meaningful source of information and should therefore be fully considered.

To summarize, emotions are an inherent part of the doctoral journeys. They show how students, in interaction with their environment, are challenged, affected in their values, needs, motivations, and perception of themselves. Students are more engaged, persistent and heathy when their needs are satisfied and when they perceive their supervisor as interested and encouraging. The need of competence and its support stand out. The results are less clear for autonomy, which emerges transiently, and for relatedness, since the personal network can be source of both support and constrain.

The aim of our longitudinal mixed-method research is to investigate significant emotional events experienced by doctoral students from a medium-sized Swiss university, and to understand what affects their well-being, and since well-being is a decisive factor of accomplishment, to identify which needs must be met to ensure it.

2. Research context and methodology

The University of Fribourg hosts about 1200 doctoral students a year. Each department rules the framework and requirements for its doctorate. The Swiss federal statistical office estimates the graduation rate in the years 2005–2009 from 90% for exact and natural sciences, to 54% for economical sciences, at 69% for Social Sciences and Humanities (SHS).

26 doctoral students participated in this longitudinal mixed method study: 21 women and 5 men, age between 25 and 59 (m=32). 58% work as assistants, 39% take part in a funded research project, 3% work in the private sector. All fields of study are repre-

sented except Medicine and Pharmacy; 69% study SHS. 66% are in the stage of data collection and analysis, 19% work on the project, and 15% are finalizing their research and thesis. During the research, one student dropped out of doctoral studies.

The participants were asked to report significant emotional events on the spot, during 3 weeks between October 2016 and January 2017. With an adapted version of the Geneva Appraisal Questionnaire (GAQ, Scherer, 2001), they described for each event their subjective feeling, i.e. the verbal description of the emotion(s) as experienced (conscious aspect of the emotional process). They also sketched and evaluated the triggering event, its personal and situational antecedents, and its consequences.

The qualitative data of the 256 reported events were content coded in a mixed categories approach (L'Écuyer, 1990) starting from the Geneva Affect Label Coder (GALC, Scherer, 2005) and the Doctorate-related Need Support and Need Satisfaction short scales (D-N2S; Van der Linden et al., 2018). The analyses were intersubjectively validated with each participant in a follow-up interview, to ensure that the meaning they gave in their narration had been preserved. The final sample encompasses 191 events (75%) that, according to the students, affected their doctoral process and subjective well-being in an impeding or facilitating way. Events of neutral impact or with missing answers were dismissed (25%).

Globally, students either experience facilitating events that satisfy their needs of competence, relatedness and autonomy, which leads to more vitality; or they are confronted with impeding events that thwart these needs, which lessens their well-being. The next section reports the facilitating and the impeding events, the most experienced emotions, and how needs were affected. The findings are illustrated with a few narratives (translated by us from French to English, and slightly synthesized). Participants' names were changed, and some details removed to ensure anonymity.

3. Facilitating events

93 (49%) of the 191 analyzed events affected the doctoral process and the student's subjective well-being in a beneficial way. The most frequent emotions[1] resulting from those events were contentment (53%), relief (36%) and hope (24%). They arose separately or jointly (emotional blends). 40% of the 93 events triggered concomitantly unpleasant emotions (mixed emotional patterns), mostly anxiety and fear (related to social interaction), however without compromising the well-being.

3.1. Need satisfaction

The three basic needs – competence, relatedness and autonomy – were satisfied, when students felt mastering and effectance, got adequate support, and saw their commitment acknowledged.

3.1.1. Competence satisfaction (67 out of 93 facilitating events | 72%). The students perceived a sense of progress (e.g., find new elements, complete data or analysis, get results, make headway in the writing) and/or accomplishment (e.g. achieve a goal, overcome a challenge). They also described the feeling of mastering the task or learning something useful. 22% of the events triggered interest.

"I submitted the third article of my thesis. It was a real challenge because I wrote it in English, hence a certain satisfaction. I am now waiting for the feedbacks of the reviewers, which worries me. A major step forward in my cumulative thesis process, even if the acceptance of the article will be even more essential." (Eric, SHS)

3.1.2. Relatedness satisfaction (22 events out of 93 | 24%). The students felt integrated in their proximal teams and interacted warmly on a collaborative and mutual supportive basis (e.g. feeling of belonging and mattering, care taking if things get rough). They also valued the exchanges with distal actors like participants to their research and supervised undergraduate students (e.g. warm interactions, perception of implication and gratefulness).

3.1.3. Autonomy satisfaction (21 events out of 93 | 23%). Students felt volition and experienced self-regulation (e.g. find a balanced organization of activities, dedicate time to work on their research or for recovery) and were globally satisfied with their time management. Other times, they felt a regain of self-endorsement (e.g. meaning of doctoral studies, balanced priorities in life). 71% of those events satisfied the competence need concomitantly.

"I have decided to change something in my work strategy: I work in the morning on what requires the most energy and concentration and leave for the afternoon "lighter" or less intellectual things. Especially, I do not work on the interviews transcripts in the morning [...]. Today, I tested this new way and it works, which motivates me." (Romain, SHS)

3.2. Supportive environment

For 36 out of the 93 facilitating events (39%), students mentioned environmental support – structure

[1] For extensive definitions see Sander and Scherer (2009a).

and implication practices very often, autonomy support infrequently.

3.2.1. *Structure* (25 events out of 36 | 69%). Students described forms of guidance such as constructive and informative feedbacks, joint exploration of ways to address difficulties. Providers were mostly their supervisors, then close peers, and to a lesser extent the scientific community or members of their teams. In 25% of the events, the supervisor evoked their confidence in student's success. Scaffolding rarely emerged.

3.2.2. *Implication* (16 events out of 36 | 44%). The students felt that they, and their research matter (e.g. interest, warmth). They felt secure to discuss their standpoint, and confident. Providers were mostly supervisors, to a lesser extent peers and teams. 75% of these practices also involved structure.

Two events illustrate the importance of proximal network resources and emphasize the possible ambivalence of social interactions, and the experienced rollercoaster between and within events.

"I had an appointment with my supervisor this morning. I had sent him beforehand parts of my thesis to read and I had specific questions regarding these parts and other points. I dreaded this appointment because previous exchanges were superficial since he hadn't read the documents I had submitted and shortened due to time pressure. Today, I got pragmatic feedback. I feel confident to continue writing my thesis. I know where I am going, and I feel like I will succeed." (Daphné, SHS)

"I asked a few people to critically assess a questionnaire I had prepared for my research. I don't like asking people because I know that everyone has a lot to do. So, I hesitated to contact them. After receiving a positive answer, I feel content and encouraged to continue. I'm waiting for the others to respond. If all agree, I'll make great progress." (Eva, SHS)

4. Impeding events

72 (38%) of the 191 analyzed events affected the doctoral process and the student's subjective well-being in a harmful way. The most frequent emotions resulting from those events were frustration (35%), stress (32%) and anxiety (29%). These unpleasant emotions arose separately or jointly (emotion blends), when basic psychological needs were thwarted, i.e. when students felt incompetent, saw their efforts, plans or ambitions hindered, thought that their opinions, goals, needs or resources were disregarded, were not given the expected support.

Figure 1. *Frequency of need satisfaction and need support in emotionally significant facilitating events (n=93) and thwart in impeding events (n=72).*

4.1. Need thwarting

The thwarts of competence and autonomy stand out clearly in the event descriptions. The thwart of relatedness appears to a lesser extent.

4.1.1. Competence thwarting (42 out of 72 impeding events | 58%). Students felt incompetent, doubted their capacity to succeed, to meet their supervisor's perceived expectations, and/or to measure up to the norms and practices of the scientific community. They also assessed severely what they had achieved so far (e.g. the quality/quantity of data or analysis, the argument construction); thought the outcome would lack in depth; encountered setbacks (e.g. equivocal analysis or results); felt stuck, going round in circles or getting behind schedule. They mainly questioned their own organization (e.g. planification, tasks consuming more time than expected), but also often compared themselves to others (peers, skilled researchers, etc.).

"I'm reading a very interesting book. I feel that I don't know enough theory, didn't read and think enough in the past years. I have the impression that I will never be able to produce something like this, to argue so well and to make all the theoretical and practical linkages necessary to elaborate such a text." (Sonia, Sciences)

4.1.2. Autonomy thwarting (40 events out of 72 | 56%). The students reported mostly time scarcity and pressure (deadlines); little or no control over daily work and organization (e.g. professional overload, unexpected demands, technical issues, organizational setbacks in research such as participants' dropout, family contingencies preventing work on their doctorate). Occasional health issues constrained their doctoral process over several days or months. Sometimes they felt a low sense of volition or self-endorsement (e.g. doubts about their own decisions, the meaning of their doctorate, their place and career in academic settings). Half of the events thwarted the competence need concomitantly.

4.1.3. Relatedness thwarting (10 events out of 72 | 14%). Students felt cut out from their team and proximal peers (lack of authentic and warm relations, no exchanges on personal level, competition, lack of involvement of team members and mutual aid) or felt uselessness within the team. Three students mentioned the lack of understanding or support from their relatives.

"*We are not a team. It's every man for himself. People choose with whom they go for lunch based on the person's reputation and how it can benefit them. I don't care about titles or such things. The person itself is what matters. Situations like that make me doubt to continue in that job.*" (Maria, SHS)

4.2. Constraining environment

In 28 (39%) of the 72 impeding events, students explicitly reflected on their research environment, mentioning most frequently rejection, control and chaos practices.

4.2.1. Rejection (18 events out of 28 | 64%). Students mentioned mostly difficulties in the relation with their supervisor: lack of availability when support was needed (e.g. feeling of being neglected or left to one's own devices); perception of unethical or inappropriate behaviors (e.g. demands and situations the students deemed illegitimate or damaging for themselves or their research, pressure to work on weekends); lack of recognition for the work carried out or one's involvement; conflict and tension in the relation (e.g. feeling psychological insecurity, rude interactions, no personal concern). Students also expressed a few unfulfilled expectations towards the research team, or peers.

4.2.2. Control (15 events out of 28 | 54%). Activities that are imposed, too tightly defined to allow for any leeway in their handling, means or contents, or seen as disregarding the students' opinion, goals, needs or resources. Time pressure because of deadlines set by others (e.g. supervisor's agenda, submission deadline, end of contract or grants).

"I have so much to do for the assistantship and lots of private things for my supervisor that I think he should do himself (e.g. his parking sticker, […]). This succession of small tasks is very time consuming. I have not touched my research for weeks … it's very frustrating because the deadline for submitting my paper to a conference approaches. I would like to clone myself." (Alice, Economics and Social Sciences)

4.2.3. Chaos (11 of 28 events | 39%). Lack of, negative or contradictory feedbacks, lack of guidance or tutoring, and little support perceived to publish or to network.

"A discussion with doctoral colleagues made me aware of the difference between their progress and mastership and mine. Some of them work on their fourth article, others are writing book chapters, while I had not yet the opportunity to write a single article. I think it is because they work in the research team of my supervisor, with many more opportunities to communicate." (Julie, SHS)

5. Ambivalent events

26 of the 191 analyzed events (13%) showed opposed effects. Adaptive regulations (e.g. stocktaking, planning) were beneficial to the doctoral process but affected negatively the students' well-being when their (not extensible) resources reached their limit under time pressure. The perception of the social context was also ambivalent: while students saw formal and non-formal contacts as interesting, and nurturing progress (e.g. for feedback, affective support), they also experienced them as sources of stress, fear and anxiety (e.g. image as professional; comparison, etc.).

6. Discussion

The satisfaction of the three basic and interconnected needs of competence, relatedness and autonomy is a requisite for the well-being of doctoral students. Put metaphorically, "well-being is like a three-legged stool; pull out any one of these supports and the stool will fall" (Ryan & Deci, 2017, p. 256).

The students' need of competence emerges prominently, in line with earlier studies. In facilitating

events, the sense of moving forward with one's research (e.g. refining the project, finding new theoretical elements, collecting data, obtaining results, proceed in writing) stands out, whereas when facing obstacles (e.g. work overload under time pressure, be stuck in complex analyses without a resource person, inconsistent results, non-acceptance of submission, feel controlled, face unforeseen circumstances), students tend rather to doubt themselves, their skills, and their motivations.

Social interactions are crucial in both types of events. In facilitating events, they are significant providers of landmarks, particularly in "hidden" or non-formal activities. Doctoral students are in a complex learning and professionalization process to become researcher. The supervisor (mostly), peers, members of the team or of the broader scientific community help them to appreciate what contents, methodologies, practices, or behaviors have more value and meaning, which ones have less, and why (Ryan & Deci, 2017). In contrast, except for some formal events (e.g. certifying activities, trainings), the environment does little to help students acknowledge the skills they improved. Indeed, structure and implication practices appear largely as environmental affordances in the facilitating events, supporting the process of internalization of social practices (Ryan & Deci, 2017). Yet, their proximal and distal networks also help the students to find their places as members of the scientific community.

In impeding events, many students tend to have doubts about themselves, not only regarding the regulation of activity, but questioning their ability to complete the doctoral degree, their motivation or their place in academic settings. This raises the question as to whether the students internalized the inclination of the scientific community suggested by McAlpine et al. (2012), and therefore see themselves as the source of every difficulty without considering little that the problem may be structural or conjectural. Moreover, substantial identity processes take place during doctoral studies, as highlighted by the European project "Researcher Identity Development[2]". Our results show how emotionally ambivalent some students can feel about their proximal and distal network. When they perceive their ineffectance in handling certain situations, they may see others as a threat (for their self-conception or their feeling of legitimacy within the community, thus steering up self-preservation or defense strategies) rather than seeing others as an opportunity to learn and progress. Taking the assumption of Devos et al. (2016), it seems that relatedness satisfaction and its supports "oils" the doctoral process by facilitating structure (e.g. taking in feedback) and autonomy.

Being autonomous does not mean working detached from others, without any influence or dependence (independence), nor does it mean to operate without constraints (freedom). Autonomy means "acting in accord with one's reflective considerations" (Ryan & Deci, 2017, p. 51), thus accomplishing actions characterized by self-endorsement (tied to values, interests, etc.) and volition (e.g. operating choice, regulation).

In our results, autonomy appears much more frequently when students feel it thwarted than when it is satisfied. This could be because autonomy is a "vehicle" through which other needs are actualized (Ryan & Deci, 2017) – autonomy being rarely mentioned in facilitating events because it is not blocking the satisfaction of other needs. However, autonomy can't be taken for granted. It is variable and potentially vulnerable, depending on individuals but mostly on support given by the social environment. Thwart of autonomy appears globally in three circumstances: 1) work under perceived duress and coercion (e.g. conflict with values, interests, opinions, intentions); 2) difficulty to juggle and reconcile all spheres of life (e.g. employment as assistant, doctoral studies, family care and social life), to manage resources and time; 3) facing the unpleasing meanders of the ordinary research process, experiencing uncertainty, setbacks, wanderings, unforeseen situations.

In the first two cases, students cannot act with full volition, nor contribute with their whole resources, interests and capacities. The danger when the context fails to support autonomy, is that students are less likely to learn and internalize values, attitudes, or behaviors of the reference group. The internalization process will rather have the quality of introjection (in a sense of one "must" or "should" do something, or feeling anxiety, self-disparagement), thus being conflicted, rigid, or marked by negative emotionality (Ryan & Deci, 2017). For instance, when a positive informational feedback is delivered in a controlling style, the potential effect of competence information is not only neutralized but could also undermine intrinsic motivation (Ryan & Deci, 2017). Supporting students' autonomy implies to be responsive to their point of view, state of knowledge and skills, as well as to important issues they might face. Providing autonomy is offering an evolving framework in which doctoral students can grow, progress, then initiate meaningful and self-endorsed choices (e.g. choose certain axes of their research) and build their own researcher posture. That also means ensure a work

2 *https://www.researcher-identity.com/* (3 October 2018)

Recommendations for people interacting with or supervising doctoral students to create supportive environments (adapted from Ryan & Deci, 2017)

Autonomy supporting practices
- Clarify own role, expectations and limits
- Understand and relate to the doctoral student's perspective (e.g. values, interests, aspirations, learning project)
- Provide choices and meaningful inputs (e.g. options that were overlooked)
- Provide a meaningful rationale for activities (tying to include the student's perspective)
- Be responsive to questions and comments
- Consider carefully the use of incentives or controlling pressure because of their potentially damaging effects on motivation (avoid them if possible)
- Consider employments' conditions of students (esp. in case of double duty as supervisor and head)
- Suite the accompaniment practices to student's progression and needs within the studies.

Competence supportive practices - provision of structure
- Offer constructive informative feedback (versus pointing out insufficiencies, mistakes, etc.)
- Acknowledge signs of mastery and improvement
- Encourage and accompany autonomous reflection (e.g. identification of obstacles and concerns, problem solving)
- Clarify implicit values and practices within the scientific community
- Provide expertise and scaffolding
- Help building network (esp. for students with individual research projects)

Relatedness supportive practices - provision of implication
- Dedicate (quality) time
- Take interest in the person
- Create a secured and trusted relation involving authenticity, empathy, openness
- Acknowledge the student's experiences and feelings

Figure 2. *Recommendations for people interacting with or supervising doctoral students to create facilitating environments.*

environment that enables opportunities to practice and acquire knowledge and skills (e.g. honor employment contract and allow time for the doctoral work or trainings, provide a suitable infrastructure).

The third case of thwarting autonomy could emphasize the vision (especially novice) students have of a "good" researcher or research process. The production of the thesis requires a series of high level academic competences in relative autonomy compared to the learning achieved so far at Bachelor or Master degrees (Frenay & Romainville, 2013). Having seen mostly completed outcomes (e.g. publications), students could be only little aware of the iterative nature of the research process, with its headways and setbacks, wanderings, refinements and rewritings, that their supervisor and other skilled members of the scientific community also commonly experience. They could still be little equipped to regulate and handle such unpleasant fluctuations. Scaffolding activities with experts, open discussions with the supervisor about such experiences, engage in junior researcher associations in the field (to organize conferences, participate in review process, etc.) are just a few ways that could support this learning process.

Lastly, in the emotional rollercoaster experienced during the doctoral journey, stress was expressed by more than 80% of the students and often assessed as chronic. Like anxiety and despair, stress can, in case of long-term recurrence, lead to exhaustion, psychological distress or psychological disorders (Nevid, Rathus, & Greene, 2009). As emphasize in the introduction, these results are worrying in view of the risky context in which doctoral students evolve (e.g. duration of studies, evaluation, high competition).

On the brighter side, contentment was very frequently verbalized by almost all participants. This state of being satisfied and comfortable with the actual circumstances, of feeling a sense of accomplishment, should, when often experienced, sustain individuals in building self-knowledge and refining their value systems (Fredrickson, in Sander & Scherer, 2009a) as well as reinforce involvement and ties to others (relatedness). Relief, hope, and interest were also frequently reported. These approach emotions stimulate exploration, creativity and learning. They are associated with effort, persistence and reduction of distress (Tran, in Sander & Scherer, 2009b). They are thus a powerful lever of learning and research processes in higher education.

The health and persistence of doctoral students cannot be reduced to an individual matter. They also depend on how environmental conditions support or thwart their thriving (Ryan & Deci, 2017). The flourishing of students includes not "only growing in cognitive skills and knowledge but also developing and strengthening personal and social skills" (Ryan & Deci, 2017, p. 380). By sustaining the satisfaction of doctoral students' needs, the people who support them do provide an environment conducive to well-being, motivation, learning, performance and creativity, but are also facilitating their professional socialization. Recommendations in this regard are proposed in Figure 2. See also the booklet[3] on doctoral supervision edited by Dr. Marie Lambert and Prof. Bernadette Charlier, and published by University of Fribourg Didactic Center.

7. Limits and perspectives

[3] *https://www3.unifr.ch/didactic/de/services/accompagnement/accompagnement-des-doctorants/*

This research does not give a voice to supervisors and institutions on their roles, responsibilities and their representation of supervision or its quality. Nor does it question whether their conceptions match the expectations of the students. More research is needed in this field.

Regarding the number of volunteer participants (26), the generalization to all doctoral students in Fribourg and other contexts should be made with caution. Nevertheless, our methodology has provided rich data, which complements the findings of Marie Lambert[4] who, in her thesis about the professional development process of assistants and doctoral students, emphasizes the crucial role of the organizational context framing the studies (e.g. working conditions) and of the proximal peers and teams as significant resources, as well as the ambivalent relation to the supervisor. Our findings are also, in many aspects, in line with the above-mentioned Europa Studies.

An essential aspect that needs yet to be considered, because it also distinguishes those who complete their studies from those who don't, is the students' involvement in a project that makes sense (Devos et al., 2016), and meaningful motives underpinning their engagement, for example wanting to solve vocational problems (Vekkaila et al., 2013). The aspirations (the "what" – intrinsic versus extrinsic goal contents) and the motivational orientations (the "why" - autonomous versus controlled regulation), also make the difference in health, as a component of the eudemonic well-being process (Ryan & Deci, 2017). Forthcoming analyses will focus on understanding these motivational aspects in key events. How do students with an intrinsic motivational profile react when activities don't interest, stimulate or absorb them? How do they persevere? Identified regulation - i.e. seeing the personal relevance of activities like discovering tools for the aspiring professional career - should sustain the learning and internalization process, as Vansteenkiste et al. (2018) suggest. Do such orientations help students to overcome intrinsic motivation fluctuations? Finally, are students with introjected regulation orientations, namely acting tendentiously e.g. by guilt, shame, or seeking approval of others, having more difficulties to engage in social interaction (e.g. ask for help, participate in activities)? Such in-depth knowledge will help to refine supervision practices by taking into consideration the singularity of the doctoral students and the particularity of their journey.

Although significant progress was made over the past 15 years, it is still necessary to improve the context in which the next generation of researchers will be trained to become creative, critical and autonomous intellectual risk takers, while preparing them for a variety of careers that require deep rigorous analysis[5]. The stakes are not only immaterial in terms of knowledge, but also financial (e.g. health costs) for the academic sector and for society. ■

4 Lambert, M. (2013). *Être assistant et se développer professionnellement? Recherche descriptive et compréhensive sur le développement professionnel des assistants à l'Université de Fribourg* (Thèse de doctorat). https://doc.rero.ch/record/232541/files/LambertM.pdf

5 https://www.leru.org/files/Maintaining-a-Quality-Culture-in-Doctoral-Education-Full-paper.pdf

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Stellenausschreibung - Poste à pourvoir

Ein paar Gedanken zur Anleitung von Doktorierenden

Jürg Fröhlich*

Ich habe in meiner fast dreissig-jährigen Tätigkeit an der ETH Zürich zahlreiche Doktorandinnen und Doktoranden in ihren ersten Versuchen selbständiger Forschung im Bereich der theoretischen Physik unterstützt und zum erfolgreichen Abschluss einer Dissertation geführt. Diesen Teil meiner Aufgaben an der ETH empfand ich stets als den schönsten und befriedigendsten. Viele meiner eigenen Forschungsprojekte wären ohne intensive Wechselwirkungen mit Doktorierenden und den daraus gewonnenen, wertvollen Anregungen und Beiträgen kaum von Erfolg gekrönt gewesen.

Man weiss nie sicher, wie einen die jungen Leute beurteilen würden, wenn man sie aufforderte, offen darüber zu sprechen. Es ist nicht zu bezweifeln, dass man in der Arbeit mit Doktorierenden – wie freilich in jeder Arbeit – ab und zu ohne schlechte Absicht Fehler macht und Gefühle verletzt. Ich denke jedoch, dass ich im Grossen und Ganzen meine Aufgaben und Pflichten als Betreuer von Doktorierenden mit Anstand und einem gewissen Erfolg erfüllt habe. Sonst hätte mir diese Tätigkeit vermutlich kaum so viel Freude gemacht. Ich hatte das Privileg, zahlreiche sehr begabte und hoch motivierte Doktorierende betreuen zu dürfen.[1] Nicht wenige unter ihnen schienen mir in mancherlei Beziehung viel begabter zu sein als ich es bin, (oder, ich müsste wohl sagen, war). Ich denke, ich konnte mit fast allen eine gute, aufrichtige menschliche Beziehung aufbauen, auch wenn in der Regel eine gewisse, ich denke empfehlenswerte Distanz blieb. Nur zweien unter ihnen empfahl ich, ihr Doktorat abzubrechen; und sie folgten meinem Ratschlag. Weitere zwei Doktoranden empfand ich als recht komplizierte bis unangenehme Gesellen. Sie arbeiteten ungefähr zur gleichen Zeit unter meiner Leitung und bemühten sich redlich, die Gruppendynamik in meiner damaligen Schar von Doktorierenden zu stören. Einer von ihnen hat sich mittlerweile zu einem durchaus erfolgreichen Wissenschaftler entwickelt, und unsere Beziehung ist heutzutage, wie mir scheint, gut. Der andere zeigte beträchtliche Schwierigkeiten, sich ernsthafter Forschungstätigkeit zu widmen; es waren möglicherweise persönliche Probleme im Spiel, die ihn davon abhielten. Ich konnte sie ungefähr zur gleichen Zeit mit einem Doktortitel auf ihre berufliche Laufbahn schicken. Aber, wie gesagt, mit all den zahlreichen weiteren Doktorierenden machten Zusammenarbeit und persönliche Kontakte viel Freude.

Es ist bekanntermassen riskant und unwissenschaftlich, aus einer relativ geringen Gesamtheit von Erfahrungen allgemein gültige Schlüsse ziehen zu wollen. Und wir funktionieren ja auch alle sehr unterschiedlich. Trotz dieser Einschränkung werde ich im Folgenden versuchen, aus meinen eigenen Erfahrungen und im Vertrauen auf den gesunden Menschenverstand ein paar allgemeine Regeln für die Arbeit mit Doktorierenden abzuleiten.

Regel 1: In einer menschlichen Gemeinschaft kann *nichts* offene respektvolle befreiende Gespräche ersetzen, wenn es darum geht, mit einander über wichtige Dinge zu kommunizieren und Probleme zu lösen. Man soll es vermeiden, Schwierigkeiten aller Art, etwa in einer Beziehung, per Email oder WhatsApp oder, schlimmer noch, hinter dem Rücken der betroffenen Personen mit anderen, nicht direkt beteiligten Personen zu debattieren. Die Schwelle zu gegenseitigen Beleidigungen und verletzenden Äusserungen liegt in den modernen elektronischen Medien sehr tief. Man soll sich die Courage angewöhnen, Problemen und Schwierigkeiten in der Arbeit oder in Beziehungen nicht aus dem Wege zu gehen und sie nicht vor sich her zu schieben, sondern sie in direkten Begegnungen mit der betroffenen Person respektive den betroffenen Personen anzusprechen und, wenn immer

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Jürg Fröhlich, Dr. sc.nat. ETH, ist ein theoretischer Physiker mit Sinn für mathematisch präzise Argumente in der Behandlung physikalischer Probleme. Er ist seit Herbst 2011 im Ruhestand. Sein Studium hat Fröhlich mit einer Dissertation in theoretischer Physik unter der Leitung von Klaus Hepp im Jahre 1972 an der ETH Zürich abgeschlossen. Nach zehn-jähriger Wanderschaft, die ihn in die USA und nach Frankreich führte, nahm er 1982 einen Ruf für eine ordentliche Professorur in theoretischer Physik an der ETH an, wo er dann fast dreissig Jahre bis zu seiner Emeritierung arbeitete. Er hat zahlreiche Themen der theoretischen Physik bearbeitet, u.a. aus den Gebieten der Quantenfeldtheorie, statistischen Mechanik, Festkörperphysik, Quantenoptik und der allgemeinen Quantentheorie. Er hat an der ETH zahlreiche Doktorate betreut und war für fünf Jahre Vorsteher des Departements Physik. Fröhlich ist seit 1972 verheiratet und hat zwei Töchter und sechs Enkelkinder.

[1] Eine Qualität der ETH ist, dass es praktisch in jedem Semester einige hoch motivierte und sehr begabte Studierende gibt. Einige unter ihnen haben jeweils den Weg zu mir als ihrem Betreuer gefunden.

möglich, mit Anstand und Kompromissbereitschaft zu lösen. Dabei ist es oft hilfreich, ein wenig Humor ins Gespräch einzubringen, um tierischen Ernst und Beklommenheit zu vertreiben und etwas Distanz zur Situation zu gewinnen. Viele Probleme sind ja gar nicht so gross, wenn man sie aus einer gewissen Entfernung betrachtet.[2] All dies gilt selbstverständlich auch für Kommunikation und Umgang in Gemeinschaften, die aus Personen auf verschiedenen Hierarchiestufen und mit unterschiedlichen Kompetenzen und (Macht-)Befugnissen bestehen; und ganz besonders für die Beziehung zwischen Doktorierenden und ihren Betreuern!

Ich finde es immer wieder einigermassen bestürzend, wie weitgehend uns postmodernen Menschen die Fähigkeit zum offenen, respektvollen persönlichen Gespräch abhanden gekommen ist, und wie wenig lösungsorientiert wir uns in Konfliktsituationen verhalten.

Hier wäre nun eine Untersuchung der vielen Unterlassungen im schulischen Unterricht, von der Unterstufe bis zur Universität, vonnöten, was die Förderung allgemeiner Funktionen emotionaler Intelligenz, insbesondere auch der Fähigkeit zur Introspektion und der Kenntnis unseres Seelenlebens und unserer Motive und Antriebskräfte anbetrifft. Doch würde dies das Format meines Beitrags sprengen.

Regel 2: Es ist eine empirische Tatsache, dass in zwischenmenschlichen Beziehungen gelegentlich Probleme entstehen, die derart niederdrückend und starr sind, dass ein ruhiges klärendes Gespräch unter den Betroffenen unmöglich erscheint. Diese Tatsache ist zwar zu bedauern – ich denke, sie hat viel damit zu tun, dass uns eben die Gesprächsfähigkeit mehr und mehr fehlt, und wir nicht mehr in der Lage sind, mit Empathie auf einander zuzugehen – aber wir haben sie ernst zu nehmen. In einer Situation, wo ein direktes, klärendes Gespräch unmöglich erscheint, müsste es eine aussenstehende Person geben, an die man sich vertrauensvoll wenden kann, und die dann eine Klärung der Lage und eine Befreiung aus den Fesseln eines Konflikts zu vermitteln versucht. Im Beispiel der Beziehungen zwischen Doktorierenden und ihren Betreuern ist es sicher zu empfehlen, dass jede Doktorandin und jeder Doktorand schon zu Beginn des Doktorats nebst ihrem eigentlichen Betreuer noch eine Mitbetreuerin oder einen Mitbetreuer, d.h. eine Korreferentin oder einen Korreferenten, zugeteilt erhält, an die oder den man sich im Konfliktfall – *aber freilich auch zur Diskussion wissenschaftlicher Projekte* – wenden kann. Ausserdem müsste es in jedem Departement resp. jeder Fakultät[3] eine Ansprechperson geben, die allen Mitgliedern bekannt ist und ihr Vertrauen geniesst, und an die die Doktorierenden – aber auch deren Betreuer – sich wenden können, wenn sie mit ihrem Latein am Ende sind. Eine solche Ansprechperson darf natürlich nicht in irgendwelche Departements-interne Lobbys oder Klüngel – das soll es ja geben – eingebunden sein. Sie sollte entweder aus einem anderen Bereich der Schule oder Universität kommen oder z.B. eine Professorin oder ein Professor im Ruhestand sein. Und es ist wichtig, dass eine solche «Ombudsperson» kein hypertrophisches Ego hat. Eine oder zwei Ombudspersonen für eine ganze Schule wie die ETH genügen nicht und sind in zu grosser Entfernung von der Basis.

Trifft man auf eine Schwierigkeit oder einen Konflikt, von denen man annimmt, sie seien nicht in einem direkten Gespräch zu lösen, so soll der sog. *Dienstweg* eingehalten werden: Man soll sich zuerst an die dafür vorgesehene Ansprechperson, die Korreferentin oder den «Ombudsmann» des Departements, wenden und nicht sogleich an die Schulleitung gelangen.

Regel 3: Wenn das direkte Gespräch versagt, dann kann es nützlich sein, wenn sich direkt Betroffene über bestehende Probleme oder Konfliktpotential schriftlich, kurz und stichwortartig Rechenschaft geben und solche Notizen dann allenfalls unter einander austauschen.[4] Weiterhin ist es wahrscheinlich empfehlenswert, wenn zu Beginn eines Doktorats ein paar wichtige Regeln der Zusammenarbeit zwischen Betreuer und Doktorierenden auf einer halben Seite schriftlich fixiert werden, um spätere Missverständnisse zu vermeiden. Dabei geht es weniger darum, schon die Richtung oder gar den ungefähren Inhalt einer Dissertation festlegen zu wollen. Denn diese sollten sich erst allmählich in Diskussionen zwischen Betreuer und Doktorierenden herauskristallisieren. (Es ist ja zu vermeiden, Doktorierende in schon bestehende Projekte hinein zu zwingen, wenn ihnen diese nicht zusagen!)

Es könnte empfehlenswert sein, dass die Schule respektive die Universität ein paar *allgemeine, fachgebietsunabhängige Regeln* für die Zusammenarbeit zwischen Betreuern und ihren Doktorierenden schriftlich festhielte. Es sollte sich nur um wenige, jedoch zentral wichtige Regeln handeln, und es müsste möglich sein, sie auf maximal zwei in einfacher Sprache, nicht auf zehn in bürokratischem Jargon abgefassten Seiten festzuhalten. Diese wären dann zu Beginn eines Dok-

2 Zu diesem Thema habe ich vor Jahren eine Kolumne in «ethlife» mit dem Titel «Von der Wichtigkeit bequemer Lehnstühle» geschrieben, die meinen Lesern zur Lektüre empfohlen sei.

3 Ich benütze im Folgenden das Wort «Departement», auch wenn eine Fakultät oder ein grosses Institut gemeint sein können.

4 In meiner Arbeit mit Doktorierenden wurde dies allerdings nie nötig.

torats von beiden Seiten mit Unterschrift zu akzeptieren. (Ich gestehe allerdings, dass ich kein Freund formalistischer Strukturen und von Überregulierungen bin. Aber der Trend in diese Richtung ist mir natürlich auch bekannt.)

Regel 4: *Eine Betreuerin resp. ein Betreuer von Doktorierenden muss junge Menschen gernhaben und mit Lust und Freude mit ihnen arbeiten.* Sie/er muss dazu bereit sein, mit den Doktorierenden sozusagen jede Woche längere Diskussionen über ihre Fortschritte und die Hindernisse, die Fortschritten entgegenstehen, zu führen; auch wenn diese Tätigkeit viel Zeit und Energie kostet. Dabei muss sie/er im Stande sein, grosszügig mit ihren/seinen Ideen umzugehen. Es ist keine gute Strategie, wenn sie/er zuerst die Sahne von den eigenen Ideen abschöpft und den Doktorierenden dann die saure Magermilch zur Verarbeitung überlässt. Ich habe mit diesen Vorsätzen stets gute Erfahrungen gemacht und habe dabei keine Glorie eingebüsst.

Ich habe mit einigen Generationen meiner Doktorierenden wöchentliche Arbeitsseminare und/oder Präsentationen von Ideen und Resultaten durch die Doktorierenden selbst organisiert. Auch für mich waren solche Anlässe oft sehr lehrreich. Einige Generationen fanden sie nützlich, andere hatten Hemmungen, sich vor ihren Kollegen und Kolleginnen zu exponieren. Ich hatte keine Mühe damit, mich den jeweiligen Wünschen und Bedürfnissen der Doktorierenden anzupassen.

Die folgende Forderung müsste offensichtlich sein; aber ich halte sie hier trotzdem explizite fest: *Betreuerinnen und Betreuer sollen ihre Doktorierenden nicht «versklaven»!* Es ist zu vermeiden, Doktorierende in Projekte einzuspannen, die zwar dem Betreuer wichtig sind, aber den Doktorierenden möglicherweise gar nicht zusagen. Freilich ist es erlaubt und oft durchaus ratsam, Doktorierende für eigene, wirklich gute Projekte zu begeistern und ihnen grosszügig eigene Ideen zur Weiterbearbeitung zur Verfügung zu stellen. Aber man soll sich als Betreuer stets bewusst sein, dass die Betreuung von Doktorierenden eine *hermeneutische Tätigkeit* ist.

Die heutzutage nicht selten beklagte «Versklavung» von Doktorierenden ist wahrscheinlich unter anderem eine Folge davon, dass Professorinnen und Professoren stets wachsendem Publikationsdruck ausgesetzt sind und darauf bedacht sein müssen, grosse Summen an Drittmitteln einzuwerben. Es entstehen in der Folge viel zu grosse Forschungsgruppen, die viel zu viele mittelmässige Arbeiten publizieren, und die Betreuer werden zu Forschungsmanagern. Es fehlt dann die Zeit für lange wissenschaftliche Diskussionen und kreative Unterhaltungen, und darunter leiden nicht nur die Doktorierenden, sondern auch die Qualität und Originalität der Forschung. (Dafür gibt es unzählige Beispiele!) Ich möchte wieder einmal daran erinnern, dass die Kernaufgabe der Fakultät einer Hochschule oder Universität in der Ausbildung von Studierenden zu tüchtigen Berufsleuten und der Vermittlung von Bildung besteht; *nicht* in der Publikation möglichst vieler Arbeiten in *'Nature'*.

Regel 5: Wenn schon mal ein ernsthafter Konflikt zwischen Betreuer und Doktorierenden entstehen sollte, den sie nicht selbst lösen können, dann wäre darauf zu achten, dass er von einer aussenstehenden Person so schnell wie möglich entschärft wird, *ohne* dass daraus ein grosser Skandal mit viel medialem Lärm erwächst. Die Schulleitung soll in einem solchen Fall bis zum klaren Nachweis einer Verfehlung durch den Betreuer auf dessen Seite stehen. Sonst könnte sie nämlich auf Schwierigkeiten in der Bemühung stossen, weiterhin erstklassige Leute zu rekrutieren.

Regel 6: Nach Beendigung eines Doktorats ist die Doktorandin respektive der Doktorand vom Betreuer respektive von der Betreuerin mit viel Unterstützung und Ermutigung in die Freiheit zu entlassen. Langanhaltende Zusammenarbeit zwischen Betreuer und Doktorierendem *nach* Abschluss von dessen Dissertation kann zu Konflikten und zu mangelnder Selbständigkeit des ehemaligen Doktorierenden führen.

Ich denke, ich darf hier darauf verzichten, die überragende Bedeutung von Anstand und Respekt in den Beziehungen unter den Mitgliedern von Forschungsgruppen zu betonen. Vielleicht könnte ich auch darauf verzichten, zu betonen, dass ein Doktorat kein «*free lunch*» ist, und dass es in gewissen Phasen eines solchen kaum zu vermeiden ist, dass man sich ausschliesslich auf die Forschungsarbeit konzentriert und auch am Wochenende oder nach dem Abendessen noch arbeitet – und sollte dies auch nur deshalb geschehen, weil man gerade gute Fortschritte erzielt und deshalb Spass an der Arbeit hat. Vielleicht fühlt man sich dann am Ende einer solchen Phase überarbeitet.[5] Aber wenn man noch jung ist, erholt man sich im Allgemeinen rasch wieder. Später wird man sich mit Freude und Stolz an solch intensive kreative Phasen zurückerinnern.

Abschliessend möchte ich hier noch einmal betonen, dass die Arbeit mit Doktorierenden für mich der schönste Teil meiner fast dreissig jährigen Tätigkeit an der ETH war. Ihnen gebührt mein Dank! ■

[5] Es ist bekannt, dass sich Albert Einstein in besonders kreativen Phasen, z.B. in der Endphase seiner Arbeit an der Allgemeinen Relativitätstheorie, bis zur Erschöpfung überarbeitete.

Zur Betreuung von Doktorierenden

Interview mit Frau Professor Antoinette Weibel, Universität (HSG) St. Gallen*

Frau Professor Weibel, das Thema «Betreuung von Doktoranden» ist in den letzten Monaten in den Medien häufig kritisch kommentiert worden. Als Doktorandin oder Doktorand will man ein intellektuell anspruchsvolles Thema zur Perfektionierung der eigenen wissenschaftlichen Befähigung bearbeiten, andererseits ist man oft auch bei einer universitären Arbeitsgruppe in Forschung und Lehre gegen Bezahlung tätig, hat also auch vorgegebene Pflichten zu erfüllen. In diesem Spannungsfeld kann es durchaus zu Konflikten kommen. Sie sind Professorin für Personalmanagement. Inwieweit kann Ihre Forschung für dieses spezielle Arbeitsumfeld hilfreiche Hinweise liefern?

Die Forschung zu modernem Personalmanagement fokussiert sich derzeit auf universell gültige «Erfolgsfaktoren» im Umgang mit den «Human Ressources». So sollen etwa nach Überzeugung nicht weniger Kollegen Instrumente wie «Pay for Performance» die Produktivität aller Mitarbeitenden positiv beeinflussen – unbesehen von der Art des Unternehmens oder der Persönlichkeit des Einzelnen.

Meine eigene Forschung weist in eine andere Richtung: Im universitären Kontext sozialisierte ExpertInnen lassen sich notorisch schlecht von aussen steuern – was durchaus kein Nachteil sein muss. Diese Eigenheiten des universitären Kontextes sollten beachtet werden, um die wichtig(st)en Faktoren für eine gelingende Promotion zu fördern: Motivation, Vertrauen in den Arbeitgeber, Resilienz und nicht zuletzt proaktives Verhalten.

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Antoinette Weibel, Dr. oec. publ., ist als ordentliche Professorin für Personalmanagement seit 2014 an der Universität St. Gallen tätig. Studium der Betriebswirtschaftslehre an der Universität Zürich. Promotion zum Thema «Vertrauen und Kontrolle in strategischen Wissensnetzwerken», Habilschrift zum Thema «Freiwilliges Arbeitsengagement». Antoinette Weibel ist Mitglied der eidgenössischen Stipendienkommission und im Vorstand der SAGW. Sie ist Präsidentin von FINT – dem First International Network of Trust Researchers. Sie ist passionierte Vertrauensforscherin und der Überzeugung, dass Wohlbefinden am Arbeitsplatz strategisches Ziel aller moderner Unternehmen sein sollte.

Gerade die angemessene Balance zwischen Vertrauen und Kontrolle bei den Vorgesetzten, die ja normalerweise auch die Doktorarbeit verantwortlich leiten, wird von den Betroffenen häufig bezweifelt. Es wird berichtet, dass Doktorierende sich häufig zu stark kontrolliert fühlen, sie müssen Termine einhalten, Berichte liefern usw. Was können Betreuende tun, um «richtig» verstanden zu werden?

Meine persönliche Erfahrung war eine andere. Schon als wissenschaftliche Assistentin durfte ich viel selbstbestimmter arbeiten, als ich das aus meinen Jobs in der Privatwirtschaft gewohnt war. Im Bereich der Geistes- und Sozialwissenschaften dürfte das Problem wohl eher darin liegen, dass man bisweilen zu wenig «an die Hand genommen» wird. Schon früh muss man lernen, sich selbst zu organisieren und dass vieles an einem Lehrstuhl oder auch in einer Arbeitsgruppe eine Holschuld ist. Wichtig in diesem Umfeld ist ein gutes Projektmanagement – Meilensteine und kritische Termine müssen bekannt sein – aber auch eine gerichtete Teamentwicklung. Die grösste Herausforderung in der heutzutage immer häufiger teamorientierten Forschung liegt darin, erfolgreich mit Motivationsdefiziten und Stolpersteinen in der Zusammenarbeit umzugehen. Projektmanagement und Teamentwicklung sind folglich auch die zentralen Führungsaufgaben im wissenschaftlichen Umfeld. Dies bedeutet eine erhebliche Herausforderung für uns ProfessorInnen, denn weder werden wir in diesem Bereich ausgebildet, noch sind Experten (egal auf welcher Stufe) ohne weiteres sonderlich teamfähig.

Sehen Sie Möglichkeiten, die Teamfähigkeit (im gebenden wie im nehmenden Sinne) schon während des Studiums stärker zu fördern?

Ich denke, dass wir das schon stark fördern. Im Masterstudium ist Teamarbeit nicht die Ausnahme, sondern die Regel. Wichtig ist jedoch auch, dass man die Studierenden auf die möglichen Probleme der Teamarbeit hinweist und aufzeigt, wie ein Team selbstbestimmt Motivations- und Koordinationsverluste vermeiden oder mit trotzdem entstehenden Problemen konstruktiv umgehen kann. In der HSG gehört eine solche Einführung in das Standardprogramm der Lehre.

Schon bei der Kontaktaufnahme und Rekrutierung «kommt es darauf an». Wie kann man hier Fehlentscheide vermeiden?

Ich versuche nicht nur auf die Fähigkeiten, sondern auch auf die richtige Einstellung zu achten. Das Doktorat ist ja insbesondere auch eine Qualifikationsstelle: jeder darf sich auf intensive Lernprozesse einstellen. Daher muss man keine «fertig gebackenen» Mitarbeitenden finden. Mir persönlich sind deswegen andere Kompetenzen wichtig(er), die unerlässlich sind, um gemeinsam komplexe Aufgaben zu bewältigen: Offenheit, Neugierde, Forschungsdrang, aber eben auch Teamfähigkeit, eine proaktive Einstellung und Hilfsbereitschaft. Entsprechend empfiehlt es sich bereits im Auswahlprozess auf diese Kriterien zu achten, beispielsweise indem man nebst Zeugnissen auch Schriften, Arbeitsproben (etwa eine im Voraus vergebene Rechercheaufgabe) und die Ergebnisse strukturierter Interviews einbezieht. In unserem Team werden die Entscheide zudem nicht einsam gefällt. Wir führen Interviews (immer) zu zweit durch und stellen sicher, dass möglichst viele Mitglieder der Arbeitsgruppe die Kandidierenden «beschnuppern» können.

Trotz aller Sorgfalt kommt es vor, dass nach einem positiven ersten Eindruck eine gewisse Ernüchterung oder gar Enttäuschung eintritt. Welche Fehlerquellen und Strategien zur Erhaltung und Weiterentwicklung eines guten Einvernehmens für die Zusammenarbeit halten Sie für wesentlich?

Um ein konkretes Beispiel zu nennen: Nach meiner eigenen Erfahrung scheint es häufig daran zu hapern, dass ich mir in der kritischen Zeit des «onboardings» nicht genügend Zeit nehme. Zudem sollte man die Probezeit ernst nehmen. Es wird eigentlich meist schnell klar, ob die Zusammenarbeit funktioniert. Sich in den ersten drei Monaten zu trennen, ist dann meist die bessere Option, als den Entscheid hinauszuzögern.

Ein gutes Einvernehmen entsteht, wenn ich als Vorgesetzte selbst Vertrauen schenke – den neuen Mitgliedern Aufgaben zutraue und bei unvermeidlichen Fehlern nicht harsch, sondern mit Verständnis reagiere. Gerade in der Forschung kann man aus Fehlern oder Irrtümern ganz besonders lernen – eigentlich ist das ja die Natur der Forschung: Hypothesen sollten gelegentlich auch falsifiziert werden. Zudem finde ich Offenheit wichtig – die beidseitigen Erwartungen sollten immer wieder geklärt werden, Probleme sollten frühzeitig angesprochen und Konflikte ausgetragen werden. Natürlich gelingt das nur in einem respektvollen Klima, in dem das Gegenüber als Mensch auf Augenhöhe behandelt und geschätzt wird.

Es wird oft darauf hingewiesen, dass Spannungen reduziert werden könnten, wenn es für Doktorierende keine dienstliche Unterstellung gäbe. Sollte man Doktorierende unterschiedlich behandeln, wenn sie sich (durch ein Stipendium oder eigene Ressourcen) selbst finanzieren?

Das kommt bei uns eigentlich kaum vor. Wenn jemand auf Projektgeldern sitzt, sind diese sogar meist durch (mich oder) das bestehenden Team eingeworben. Generell gilt bei uns auch in Sachen Mittelakquise, dass jeder mit anpacken muss – eine Zweiklassengesellschaft sollte unbedingt vermieden werden. Ob ein Projekt gelingt ist meist von mehreren Teammitgliedern abhängig, weshalb gegenseitige Hilfsbereitschaft und ein Verständnis von Reziprozität entscheidend sind. Natürlich gibt es Kollegen, die lieber mit einem Wettbewerbsmodell arbeiten. Dann darf man aber mit Neid, psychischer Belastung und egoistischem Verhalten rechnen – (meiner Meinung nach) keine gute Voraussetzung für eine erfolgreiche Zusammenarbeit.

Gerade angehende WissenschaftlerInnen brauchen immer wieder Ermutigung und konstruktive Kritik – wie kann man hier eine vernünftige Erfolgsermunterung und Erfolgskontrolle erreichen?

Intern ist eine ehrliche Feedbackkultur anzustreben, zu der unbedingt auch viel Lob gehört. Allerdings ist Kritik von aussen im Wissenschaftsbetrieb meist nicht sehr konstruktiv formuliert. Daher ermuntere ich meine Doktoranden sich früh auch dieser unangenehmen Kritik zu stellen – versuche sie aber durch gezieltes Coaching und die gemeinsame Einordnung zu unterstützen. Denn auch von dieser Form von Feedback kann man natürlich lernen.

Wenn man sich doch einmal vernachlässigt oder gar misshandelt fühlt – wie sollen solche Probleme angegangen und gelöst werden?

Ich versuche zu signalisieren, dass ich immer ansprechbar bin und dass es meist besser ist, Probleme eher früher als später anzusprechen. Ich habe es aber auch schon erlebt, dass gemeinsame Probleme unüberwindlich schienen. Manchmal passt man einfach nicht zueinander. Ich hielte es daher für zielführend, wenn wir auch in den Universitäten einen internen Arbeitsmarkt hätten und niemand beleidigt wäre, wenn Doktoranden den Lehrstuhl wechseln. Zudem sind natürlich auch interne Beratungsstellen wichtig. Es kann ja auch sein, dass man nicht zum Doktorieren geeignet (oder geneigt) ist. Solche Zielablösungsprozesse sind sehr schmerzhaft und müssen begleitet werden.

Unsere Gesellschaft neigt generell dazu, Konflikte zu vermeiden und, wenn es auch nur um kleinere

Meinungsunterschiede geht, schnell von Streit zu sprechen. Eine offene, unbefangene Streitkultur ist jedoch Voraussetzung für den wissenschaftlichen Diskurs, an den man sich als Doktorandin und Doktorand gewöhnen sollte. Wie könnte man die Vorbereitung auf diese Haltung begünstigen?

Man kann interne «Debattierarenen» etablieren – etwa den regelmässigen akademischen Jour Fixe. Zudem hilft psychologische Sicherheit: Es sollte allen Teammitgliedern bewusst sein, dass anderslautende Voten nicht nur möglich, sondern sogar erwünscht sind. Es empfiehlt sich offen zu kommunizieren, dass individuelle Stärken geschätzt werden und Vielfalt als Vorteil gesehen wird.

Sie sprachen eben von der Möglichkeit des «Nicht-zusammen-Passens», das nicht immer an der Kandidatin oder dem Kandidaten liegen muss. Was kann man tun, um das Auftreten und Wirken von doch gelegentlich anzutreffenden «schwarzen Schafen» unter den Leitern und Leiterinnen von Dissertationsarbeiten zu reduzieren und inadäquate Handlungen auszuschliessen?

Erstens sollte auch die Selektion von Hochschullehrenden nicht nur nach fachlicher Fähigkeit, sondern auch nach Einstellung erfolgen. Teamfähigkeit und Hilfsbereitschaft sind auch hier Grundvoraussetzungen. Das vergessen wir leider manchmal beim Zählen von Zitationen. Zweitens sollte mehr Zeit für Führungsarbeit investiert werden. In einer Studie wurde neulich dargelegt, wie wenig Zeit zum Forschen, Lehren und Führen bleibt – immer mehr sitzen auch wir ProfessorInnen in Meetings oder sind mit unserer Aussenwirkung beschäftigt. Ich finde es zwar wichtig, dass wir eine engere Beziehung zur Praxis suchen, aber diese sollte sich nicht in erster Linie darin manifestieren, Berichte zu schreiben oder Evaluationen zu bestreiten. Mehr Zeit fürs Wesentliche ist gefragt. Zudem gilt es drittens auch genau hinzuschauen, denn nicht jeder führt gerne und gut. Wer sich hier als beratungsresistent erweist, sollte vielleicht eher als Regenmacher im Hintergrund fungieren und keine grossen Forschungsgruppen verantworten.

Der Schweizerische Wissenschaftsrat hat vor einiger Zeit darüber berichtet (SWIR Schrift 2/2015), dass es zwischen der deutschsprachigen und der frankophonen Schweiz deutliche Unterschiede in der Einschätzung des Doktorats gibt. In der Frankophonie wird das Doktorieren viel stärker als Einstieg in eine akademische «Laufbahn» gesehen als in der Deutschschweiz. Aus Ihren Erfahrungen im Personalmanagement und speziell im Vertrauensmanagement haben Sie auch Einblick in viele verschiedene Berufsfelder, Berufsanforderungen und Betriebstypen erhalten. Sollte man vielleicht die Frage wagen, ob es ausserhalb der Hochschule selbst überhaupt noch Promovierte braucht?

Kritisches Denken wird immer wichtiger – und wo kann man dieses besser lernen als im Zuge eines Doktorates. Zudem vermitteln die skizzierten Anforderungen der Zusammenarbeit in der Forschungsgruppe eine zweite wichtige Praxiskompetenz: schwierige Probleme gemeinsam mit anderen Experten zu lösen. Diese zwei Kernfähigkeiten sind zweifelsohne gefragt – wir müssen nur noch besser kommunizieren, dass diese im Zuge eines Doktorates vermittelt werden.

Herzlichen Dank für dieses Gespräch. ■

(Die Fragen stellte Gernot Kostorz)

Selecting and coaching doctoral students – a view from a US engineering department

David Dunand*

This article gathers thoughts based on the author's personal experience as faculty member in two top-five departments of Materials Science and Engineering in the USA. It is a "composite portrait" based on his 27 years as a faculty member in two private universities, first as Assistant and then Associate Professor at the Massachusetts Institute of Technology (MIT, Cambridge, Massachusetts) from 1991 to1997, and second as Associate and then full Professor at Northwestern University (NU, Evanston, Illinois) from 1997 to 2018 (present time).

1. Materials Science and Engineering departments: a research-centric experience for graduate students

Materials Science and Engineering (MSE) departments, in all but a few US universities, are housed in Engineering Schools, where they are among the smallest departments, in terms of *undergraduate* student count, as compared to the much larger Electrical, Mechanical and Computer Engineering departments. However, MSE departments typically have high *graduate* student populations, in absolute terms and especially when normalizing by their faculty count, as counted as "full time equivalent" positions, which is in the low 30s for MIT (one of the largest MSE department in the US) and the low 20s for NU. In the top-tier American MSE departments, professors typically teach one class per quarter or semester, with 3–4 hours per week of class time. Teaching represents about 10–20% of their time, when averaged over the full year (there is no teaching in the summer), with another ~10–20% devoted to leadership and service activities (both in- and outside the university), and 0–10% to consulting. The bulk of their time (50–70%) is thus devoted to research, which includes: (i) raising funds, via proposal writing, (ii) executing research and (iii) communicating research, via presentation and articles. In all three areas, but especially the latter two, graduate students are deeply involved, with a rising share of postdoctoral fellows and visitors. A small part of the research effort is carried out by undergraduate students, usually mentored by graduate students.

Graduate students are thus central to the success of a MSE research group, and there is strong incentive for both the professor (the adviser) and the student (the advisee) to carry out and publish the best possible research. Incentives are generally well aligned, but for somewhat different reasons. For the graduate students, the main goal is to perform research and write a thesis to receive the PhD degree which is the gateway to employment; jobs for doctoral students are mostly in MSE-centric industry (spanning research, development, production and sales), from very large companies (e.g., Airbus, General Electric, Samsung, Toyota) to mid-size, and small companies and even start-up companies. Other MSE-related employment are also open to students with MS or PhD degrees, including: consulting, government (especially National Laboratories or Defense Laboratories), universities (as postdocs and very rarely directly as faculty members), law (e.g. patent law), medicine (implants, biomaterials), journalism (science journalism), and business. The graduate students must receive their PhD degree to access the job market, and they also depend on letters of recommendation from their advisers when seeking employment.

2. Graduate students funding

During their PhD studies, the graduate students are financially supported by their advisers through Research Assistantships (RA), paying both a living stipend and all university tuitions; these student

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expenses are the main lines of spending on the grants professors receive from governmental and industrial sources. Graduate students can also receive internal fellowships (usually for part or all of their first year) from their host MSE department. If they are American, they can apply for external fellowships – usually from the US government, e.g., from the National Science Foundation (NSF), the Department of Defense (DoD), the Department of Energy (DoE) or from US private foundation, e.g., the Hertz Foundation, the Sloan Foundation, the Xerox foundation. International graduate students also sometimes bring partial or full funding in the form of scholarships from their home countries. Another source of funding comes from Teaching Assistantships, lasting one or more semesters and consuming ~50% of the student time with teaching duties, with the rest of the time available for their PhD research. It is exceedingly rare that PhD students use their own personal funds, unlike undergraduate students who are using both loans and personal funds to pay for tuition and living expenses.

The exception to this no-self-funding rule are "terminal MS students", who are not pursuing a PhD upon achieving a final MS degree which is designed to be short (1 year) and mostly focused on classroom experience, with optional laboratory-based research. After graduation, most such students enter the workforce, occasionally returning to earn their PhD at a later date. Sometimes, undergraduate students, both domestic and international, pursue a BS-MS joint degree, for which the funding comes from the student *via* a mixture of their own funds, debt and outside or university fellowships, the latter being often need-based and covering a substantial portion of the total cost.

3. Selecting and coaching graduate students: the first few months in the graduate program

At NU and in most US universities, the entering graduate students must, within a few weeks of joining a MSE department, select an adviser and join their research group. This is done in an *ad-hoc* manner in many smaller MSE departments, but at NU, a well-defined mechanism is in place which gives the student the most choice and freedom, while taking into account the needs and preferences of the faculty. At first, the entering class of PhD students (typically 30–50 in size) listens to oral presentations by each of the faculty members who highlight their research opening(s) and describe their groups. The students are then encouraged to visit professors in their office and discuss one on one the project(s) of interest, while also gathering information on the individual advisers (e.g., their publication record, the jobs held by the group alumni), attending group research meetings, and discussing with older graduate students the adviser's mentoring style, expectations, strengths and weaknesses.

A few weeks into the first quarter, the entering graduate students rank their top three adviser/project choices. The faculty members then meet to decide on the allocation of students to their various research groups: with the full matrix of student preferences, each student name is considered in alphabetical order; for example, Student A has listed as their first choice Professor X, who is asked whether or not he/she will take them for their project. If so, student A is placed and the next student B is considered. Otherwise, Student A's second choice (Professor Y) is asked followed by, if needed, their third choice (Professor Z). Rarely are students not placed within their first three choices. This approach guarantees an active adviser choice to the student, while also giving a right of refusal to the professor, in case they feel that a specific student is not best suited for the project, and/or if more than one student has listed their particular project as their first choice. Almost every year, there are fewer students than projects, so the students are in a "buyer's market" situation, with advisers putting their best foot forward to try to convince the students to list their project(s) as their first, second or third choices.

Placement concludes when the few students who were not placed via the above three-choice mechanism are asked to select projects from the pool of unclaimed projects. Two waypoints are now in front of the student: the Preliminary Evaluation and the Qualifying Examination, as described in the next section.

4. The graduate student cursus

At the end of their third quarter (i.e. before their first summer quarter) and upon completion of nine course credits including the required core courses, students undergo a **Preliminary Evaluation** by the entire faculty; this evaluation is based on class performance, as assessed from their Grade Point Average (GPA), on research performance, as assessed from written adviser comments and on a one-page summary of research progress provided by the student. The vast majority of students receive a notice of satisfactory progress and proceed with graduate coursework and research, leading to the Qualifying Examination about a year later. A few students received a notice of questionable progress, requiring a later re-evaluation (typically after 2 additional quarters) where the outcome is usually satisfactory or, very rarely, unsatisfactory, at which point they must leave the graduate program.

The **Qualifying Examination** is the second waypoint, occurring after about two years. The student delivers a document of about 20 pages summarizing their research to date and proposing additional research for the rest of their PhD project. They present their past and future research orally to a committee made up of the adviser, two other MSE professors, and an expert from outside the university. A passing assessment means that the student is recognized as a candidate for the Ph.D. degree. A non-passing assessment means that the student cannot continue towards the PhD, but is usually given the opportunity to earn a MS degree, upon writing of a thesis. Also, before reaching the point of defending a research proposal, a few students decide to conclude their research and receive a MS degree (e.g., if their interests and plans have changed). A journal article manuscript submitted for publication is accepted in lieu of a MS dissertation document, an option often taken by MS students.

At the end of their PhD research, the students must successfully pass a **Final Examination** based on work presented in their written dissertation. The same committee who met for the Qualifying Examination conducts the Final Examination which involves an open and publicized oral presentation during a first hour, followed by an examination closed to the public lasting about two hours. In many cases, the PhD thesis consists of chapters, each of which is a published or submitted journal (or conference) article, with additional material in the thesis residing in draft article form.

About 6–12 months before defending their PhD theses, the students start looking for employment, often helped by the adviser via their contacts and letters of recommendation.

Thus, a PhD cursus consists of two main blocks of time, before and after the Qualifying Examination. Before qualification, in their first two years, the student spend about a third of their time taking graduate-level classes and passing the end-of-term exams. The rest of their time is devoted to research, to achieve sufficient preliminary results to take the Qualifying Examination. The vast majority of the students pass this exam, and with coursework concluded, they devote all of their time to experimental, computational or theoretical research, while also writing articles and sponsor reports, helping the adviser writing proposals, presenting their work at conferences and workshops, and mentoring younger graduate and undergraduate students.

5. Co-reliance between graduate students and advisers

Based on the above system, the students are *reliant* on the adviser over a number of area during their PhD career, for which there are also strong opportunities for *coaching*, when the adviser:

- identifies a research project, usually based on a funded proposal or continuing an existing line of inquiry;
- provides research opportunities outside the adviser lab when beneficial to the student's project (e.g., National Laboratories, companies, laboratories of colleagues);
- identifies conferences where the student can present their research, listen to talks and network, and provides help for preparing oral presentations and posters;
- provides scientific mentorship for the first two years, including reviewing the thesis proposal, so that they pass their qualifying exams;
- offers mentorship for the execution of the research in the later years;
- gives guidance in writing articles and the PhD thesis, from first draft to final manuscript;
- provides opportunities to present preliminary results during group meetings;
- assigns undergraduate students doing research under the mentorship of the graduate students;
- involves the student in proposal writing, both to fund their later years in the research group and for future students, and to access equipment and facilities in National Laboratories;
- writes, jointly with the student, patent disclosures based on the PhD research;
- gives the opportunity to review articles or proposals, received from journals and funding agencies;
- helps the student identify employment opportunities (in their last year);
- writes recommendation letters and provides recommendations by phone when the student applies for a job;

Other coaching opportunities are related to group dynamics and human interactions, where the adviser:

- provides a culture of lab safety, respect and fairness for all individuals during interactions between students, postdocs and adviser;
- helps conflict resolution when they arise, while also providing other resolution avenues if needed (e.g., through departmental and university channels, as described below);
- discusses and solves research ethics quandaries (e.g., how to assign authorship and author order, how to review an article or proposal which overlaps with one's unpublished research);

– insures that students are sufficiently connected to the rest of the research group so they can benefit from scientific interactions with their peers, while also avoiding redundant or competitive situations, such as students feeling pitted against other students or postdocs in a zero-sum research situation.

Finally, the student is *financially dependent* on the adviser for funding of:
– their stipend and tuition;
– their research expenses;
– their travel expenses to conferences or outside research facilities;
– their publication fees.

Conversely, the adviser is reliant on the student on many of the same points. In particular, the adviser's research productivity, as measured via publication quality and quantity, is crucial for the renewal of research proposals, which benefit the next generation of students and the overall career of the adviser. A non-performing graduate student can lead to loss of funding and damage to the adviser's reputation, making fundraising for future projects more difficult.

This co-reliance between student and adviser creates, in most cases, a strong team spirit between them, as their goals are fully aligned, i.e., to produce the best research possible, to publish it in the best possible journals, and to push science and engineering into new territories. However, the motivations and rewards, while mostly aligned, can be somewhat different: (i) for the students, their main goal is receiving a PhD degree and secure their first employment, where the means are publishing articles; (ii) for the advisers, their main goal is to publish articles (as it leads to further funding as well as recognition in the field by colleagues) while also mentoring and forming the next generation of scientists and engineers.

There is also a strong human component associated with adviser and student walking on the same research path for 4–5 years: the student learns from their adviser many "soft skills", usually by observation and "osmosis", including:
– fostering creativity while remaining able to build upon prior achievements from others;
– independence of thought while remaining able to learn from others;
– communication, both speaking and listening productively;
– perseverance against adversity but ability to determine when to cut one's losses;
– finding a balance between collaboration and independent research and thinking.

The advisers also learn and benefit from their interactions with their students, via:
– the enthusiasm and energy of somebody new to scientific research;
– the creativity and productivity of students able to focus with more time and intensity on their particular projects;
– the novel and unexpected discoveries made in the lab (or at the computer or desk) by students fully immersed in their research;
– the reward of seeing a young person grow from green undergraduate student to experienced researcher, and following their professonal trajectories years or even decades after they graduate.

6. Conflict prevention and resolution

While the vast majority of students/adviser interactions are constructive and mutually beneficial, there are cases where differences, disagreements and conflict may arise, and for which a robust network for fair and rapid resolution exists beyond the adviser, as described below for NU.

In terms of prevention, at the departmental level, all PhD students and postdocs undergo training related to Responsible Conduct of Research, consisting of an online course with nine common core modules and a five-week live course on the topic (GEN ENG 519 – Responsible Conduct of Research for Engineers). Also, there is a policy in place addressing the situation when an adviser proposes to involve students or postdocs in activities associated with their start-up company: a review takes place to ensure that the students are engaged voluntarily, that their involvement is beneficial to their development, and that their activity is not interfering with their academic progress. Finally, beginning in the 2018–19 academic year, NU is implementing a new sexual misconduct training which is required annually for all students.

Further preventive measures are also in place concerning romantic or sexual relationships between faculty and graduate students. The NU policy reads: "No faculty member shall enter into a romantic, dating, or sexual relationship with a Northwestern graduate/professional student under his/her supervision. Should such a relationship begin, the department chair must be notified promptly so that arrangements for alternative supervision and removal of evaluative authority can be made."

For students who have any concerns, the MSE department has five representatives to interact in a confidential manner: three members of the research faculty (the Department Chair, the Associate Department Chair, the Director of Graduate

Studies), the Assistant Department Chair (who is a non-research faculty member), and the Department Business Administrator. Students are encouraged to try to resolve personal conflict first by speaking directly with the other party. If they are not comfortable doing so, they are encouraged to reach out to the points of contact. If a problematic situation is identified, the Department Chair is then informed of the situation and of the plan to address the conflict, with the express approval of the student. At any time, the student may contact the Department Chair directly.

At the university level, the Office of Student Conduct (OSC) has for mission "to provide support and education to students involved in campus conduct matters, to facilitate the resolution of student conflicts, and to play a key role in educating and training students, faculty, and staff about community expectations, values and standards". Students can come to OSC to report or discuss concerns related to:

- the wellbeing of a student or the behavior of a student who may have violated a NU policy;
- sexual misconduct, stalking, dating violence, or domestic violence, with two different procedures if the person accused is another student or a faculty/staff member/third party.
- a hate or bias incident.

NU prohibits discrimination and harassment on the basis of 16 protected classes: race, color, religion, national origin, sex, pregnancy, sexual orientation, gender identity, gender expression, parental status, marital status, age, disability, citizenship status, veteran status, and genetic information. In particular, sexual misconduct is a form of prohibited harassment which is explicitly defined as any of sexual assault, sexual exploitation, stalking, dating/domestic violence, and sexual harassment. All NU employees (including staff and faculty) and graduate students with teaching or supervisory roles must promptly report to the Office of Equity all sexual misconduct allegations of which they become aware during their work for the University. Furthermore, all personnel in teaching or supervisory positions (including Teaching Assistant students) must report allegations of discrimination or harassment to the Office of Equity. Further support services are provided by the Women's Center, the Center for Awareness, Response & Prevention (CARE), and the Office of Institutional Diversity and Inclusion

7. Conclusions

Professors and their PhD students, as research advisers and advisees, are scientifically and financially reliant on each other, and have aligned incentives and goals: doing the best possible research and publish it in the best possible journals. This alignment results in a smooth journey through the PhD program for most students. Because conflicts are unavoidable in any human enterprise, the university is offering a variety of prevention and resolution avenues, acknowledging that students have less power than advisers and must therefore be offered respect, support and protection. ■

A professorial view of PhD supervision in the light of doctoral training initiatives

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Ursula Keller, Ph.D., has been a tenured professor of physics at ETH Zurich since 1993 and also a director of the Swiss multi-institute NCCR MUST program in ultrafast science since 2010. She received the Ph.D. from Stanford University in 1989 and the Physics "Diplom" from ETH in 1984. She was a Member of Technical Staff (MTS) at AT&T Bell Laboratories from 1989 to 1993, a "Visiting Miller Professor" at UC Berkeley 2006 and a visiting professor at the Lund Institute of Technologies 2001. She has been a co-founder and board member for Time-Bandwidth Products (acquired by JDSU in 2014) and for a venture capital funded telecom company GigaTera (acquired by Time-Bandwidth in 2003). Her research interests are exploring and pushing the frontiers in ultrafast science and technology. Awards include the European Inventor Award for lifetime achievement (2018), IEEE Photonics Award (2018), ERC advanced grants (2012 and 2018), OSA Charles H. Townes Award (2015), LIA Arthur L. Schawlow Award (2013), EPS Senior Prize (2011), OSA Fraunhofer/Burley Prize (2008), Leibinger Innovation Prize (2004), and Zeiss Research Award (1998). OSA, SPIE, IEEE and EPS and IAPLE Fellow, member of the Royal Swedish Academy of Sciences, Academy Leopoldina and Swiss Academy of Technical Sciences. She supervised and graduated 74 Ph.D. students, published 448 journal publications and has more than 22'000 citations and h-index of 77 (Web of Science core Collection, 10th August 2018). Ursula Keller is a member and Founding President of ETH Women Professors Forum, see *https://eth-wpf.ch*.

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1. Introduction

Over the last decade in many European countries the modern doctorate is described as "determined by an interplay between professional research experience and personal development, the most important outcome of which is an individual trained to have a unique set of high-level skills [1]." This has led to a growth in structured doctoral programs, which are set alongside the doctoral training within "research intensive environments where excellence is fostered [1, 2]". This article outlines the professorial experience of doctoral training within an experimental physics group. It also describes the growth of wider professional development skills training arising from the research network NCCR MUST (National Center for Competence in Research Molecular Ultrafast Science and Technology). Some of MUST wider skills training was created within the equal opportunities program for this research network. The goal is to present a detailed picture of the outcomes of PhD training within a professor's group, whilst setting this within the context of other career development provisions now available. From the professor's viewpoint doctoral training within a group can develop independence, critical thinking, creativity and teamwork skills. The parallel career development programs offered by graduate schools and structured doctorates enhance the "transferable skills" of the doctoral candidates embedded in the research teams.

2. The role of professors

The core mission of our universities – and professors – is education and research. In the Swiss education system, a Bachelor's degree focuses on the basics in the different fields of expertise, and at ETH Zurich for example, there is strong emphasis on a broad mathematics education for all of our science students. Master's degrees aim to strengthen fundamental knowledge in a specific research area and, as such, bring students closer to the forefront of current knowledge in a focused field of research related to the expertise of appointed professors. Master students at ETH conduct a 6-month guided research project within an active research group.

Students who excel in the first two steps are often interested in research and continue to study for a PhD. Often these doctoral students come from all over the world. They have the opportunity to do cutting edge research under the guidance of a professor and group leader. This research often generates

results that advance our current knowledge horizon. PhD candidates learn that research is performed in a "learning by doing" environment alongside their professor, supervising senior scientists and post-docs, and working in teams with other PhD students.

The professors in leading the research in their groups set the vision, the goals, and select group members including the PhD candidates, senior scientists, postdocs, laboratory technicians, and office managers. They are responsible for generating sufficient research funding to cover the salaries of their team and the running expenses of their research. Necessary running costs for a group can vary in size depending on the research field – for example a theoretically-oriented professor may require investment in high level computers for modelling, while groups at CERN may require many millions of francs to build their state-of-the-art machines.

A professor is responsible for setting and maintaining the standard of the research done in his or her group, keeping it relevant to the field and the international competitive R&D activity. A professor's activities create undergraduate and master courses, graduated PhD students, trained post-docs with specific expertise, and a range of research outputs, published papers, conference presentations, and even industrial applications.

The excellence of a leading professor is key to developing knowledge horizons in research at world-leading universities, such as ETH Zurich. Professors are required to follow a high scientific standard in research and publications ensuring open access to all, beyond political borders and interests. With this open access professors stimulate each other to excel beyond our individual efforts – which supports faster progress – from which the entire human population can benefit. Leading research professors often pursue knowledge horizons which do not have an apparent or immediate commercial application, but history shows that eventually much of this knowledge may result in significant new economic activities, or medical breakthroughs, or even new conceptual ways of thinking – often in ways that were difficult and sometimes even impossible to predict. It is our mission to push the horizons of knowledge and share our findings openly, meaning that we have significant public responsibility and accountability for the research we generate.

ETH Zurich gives its professor competitive advantage by providing core funding in each field. We can conduct early feasibility tests, explore new opportunities and apply, from a strong position, for the competitive external funding opportunities. The benefits from this internal investment, or core funding, means that we compete well in the funding processes where success rates can be below 10%. It is also important not to forget that ETH Zurich, as a world-leading university, is set within a Swiss landscape and the research work generated from the university means that the university brings benefits to the community: Swiss students have access to a top-rated international university; we attract excellent international students who contribute to industry; we support Swiss industry by exploring limits and tackling fundamental challenges which introduce technological breakthroughs as early as possible; we increase international investments by drawing in companies with research labs such as IBM and Google; and we leverage the know-how of ETH Zurich to create successful spin-off companies.

New PhD students are embedded into this research landscape, within their chosen department, for approximately four years, the usual time allocated in Switzerland.

3. The organizational structure of the ultrafast laser physics group

This particular research group has been working in the field of experimental physics over the last twenty-five years at ETH Zürich. During that time more than seventy PhD students have graduated successfully.

Within the group the research is divided equally between applied and fundamental research, as are the PhD students. Applied research has meant looking for solutions to technological problems and fundamental research that was motivated by the professor's curiosity to see what happens when pushing measurement techniques into a regime where nobody has been before. For example, the research group has made many key innovations that enabled ultrafast lasers to be used for industrial applications [3]. On the fundamental research side, it has pushed the frontiers of ultrashort pulse generation enabling access to new observations on a timescale never accessed before [4]. During the research journey unforeseen challenges and problems are encountered, which need to be solved and very often open up new ideas and opportunities for the next research steps. Researchers become explorers who can uncover unexpected and unpredicted new opportunities. For example, the group demonstrated new world-record short pulse durations, we solved the problem that the transient electro-magnetic field within the short laser pulse is not stabilized, and the solution to this problem [5] not only enabled our community to

observe dynamics on 1000-times shorter time scale in the attosecond time regime (1 attosecond = 10^{-18} s) but also revolutionized frequency metrology with the frequency comb technology.

The whole research team is a crucial part of this effort. The professor compares her efforts to a small high-tech "business unit" where the professor is equivalent to the Chief Executive Officer (CEO) and the Chief Technology Officer (CTO). The group's "products" are courses and lectures, the graduated students, the experienced post-docs, and the research results, e.g. published papers and conference presentations. From the early days in the 1990s this group grew quickly to a size of approximately twenty-five people including PhD students, senior scientists, postdocs and a technician.

The key responsibility of the professor is to generate sufficient research funding to cover the salaries of the team and the running expenses of the research laboratories. ETH Zurich provides core-level financial support which is multiplied by successful applications to competitive funding schemes at ETH Zurich, the Swiss National Science Foundation (SNSF), European funding programs and industrial application. The more successful the research, the more additional resources can be acquired. All the PhD students are partially supported by these external funding sources. They have access to the proposals that elaborate the research plans for the next three to four years, which means that they are informed about the group's research mission. The PhD students and postdocs also support the education of Bachelor and Master students at ETH Zurich by working as teaching assistants.

Clearly there are key differences between the business unit model of an industrial effort and the research group. The PhD students acquire training and expertise over a four-year period and then the majority leave to take their skills to industry, the public and private sector and the academic system. The research group works continually to push the frontiers of knowledge in a world-wide competitive effort. The investment in the educational development of the PhD students justifies the core funding from universities, which acknowledges those efforts and the overall performance.

Every person in the group counts and we need people who are qualified, passionate about investigating the unknown and interested in striving for new findings. Research is never a straightforward process.

4. Selection process for PhDs to the group

All potential candidates are selected after a full-day's interview with the professor and group members. They are given the opportunity to visit the labs, meet the group members individually and to present the research work from their Master project. This selection process reveals the match between the candidate and the group, and also shows whether their level of expertise is related to the group's needs.

In experimental physics the research effort is based on a team work where each student is responsible for a certain task within a larger research team. Initially every new student works with a more senior PhD student to be given basic training in aspects of their work. At this stage they are introduced to the research procedures within a group in depth, with all the challenges, uncertainties and problem-solving skills needed. They learn that if an experiment doesn't go as planned, it could be due simply to a wrong cable connection or any number of other technical reasons – or it could even herald a wonderful new discovery! Working in a physics laboratory environment requires patience, continual learning and dedicated application to solve problems from small practicalities to fundamental challenges. This group is designed to create a state-of-the-art laboratory, which also has a supportive environment within the team, where people can achieve greater things than they could ever have imagined. The professor's motto is: nobody said it's easy, so try harder.

In an experimental physics group, as with any group, there is a wide range of experience levels, with some truly outstanding members who contribute to all levels of the team. The students who dedicate themselves early to striving for an academic career can often benefit from a wide engagement in a group's research. For example, whilst they give broad support to group members they also become co-authors of a wider range of publications as a result of their contributions. All PhD students are involved in every step along the research process starting from key component fabrication, to system integration and final performance characterization. This gives each student the opportunity to better understand their specific talents and interests. Experience shows that the teams self-organize to help each other.

It is a central goal that towards the end of the PhD time the students will be able to access knowledge about their own abilities and performance, which enables them to make the right choices for their next career steps in a way that combines their interests with their natural talents – ultimately doing something that makes them happy and successful.

5. The PhD student process and formal training within the group

All students who join the group read and sign a short document, which presents the group's operating principles with regards to scientific research efforts, scientific publication guidelines, attendance at conferences and overall lab safety measures. The number of rules is limited and focused by the overall goal of research excellence and intellectual freedom, which means that the rules remain practical and enforceable.

Every PhD student has the opportunity to attend an international conference within their first year, either with or without a paper or poster contribution. Afterwards they attend such conferences only if their submitted contributions have been accepted for an oral presentation. For certain conferences an accepted poster presentation is also considered sufficient. Joining the research process means learning that to achieve results takes time, depends on the central problem under investigation, challenges with the technology and whether you are working to establish a breakthrough. Resilience can be a quality developed in the process.

There is a particular emphasis placed on training students to develop and improve their scientific presentation skills. Sessions for practice talks, attended by the whole group, including the professor, precede all conferences. The outcome is that many students win the best student presentation awards at conferences, which are awarded both for an excellent research result and an excellent presentation.

A further experience in this group is the opportunity to learn to interact with the industrial sector – purchasing equipment for the laboratories, solving technical problems that develop in some of the larger machines and lasers, engaging in technology transfer processes and spin-off initiatives. This experience provides links to industry and gives personal development in solving the concrete problems that develop naturally while maintaining and running a state-of-the-art lab. External collaborations are coordinated and approved by the professor, but then all group members are also in direct contact with them, for example when their experimental work is underpinned by external international theory groups.

During the last year of the PhD period there is normally a formal meeting where a PhD student summarizes their goals leading up to the PhD exam. These meetings are often a real pleasure for the professor because the summaries are so well written. If anything, the only problem can be that these goals may be too ambitious within the short time frame, so it's the professor's task to give a realistic perspective here, in order for them to meet the PhD exam deadline.

The professor's philosophy is that over the PhD period a student will develop independence, self-management and challenge him- or herself intellectually and experimentally, which may involve some tough times finding a way through to scientific and practical solutions. An open-door policy means that all the students can approach the professor and/or can organize a meeting in advance. They are expected to be prepared and to produce a written summary of the current status, the problems and a first proposal of how a solution may be found. Very often this preparatory process points to solutions, or even a resolution in advance.

It gives the professor great pleasure to see the PhD students who excel in this environment. Often, they bring new ideas that went well beyond the initial proposals and some students even redefine their PhD research work. For a professor to see, in a young researcher's eyes, how much their independent efforts mean to them is a real pleasure. These are the students one encourages to continue within the academic system. It also positive to observe the others who move to successful jobs in industry and the commercial sectors, or even start their own spin-off company from the results obtained during their PhD, which is also explicitly supported by formal programs at ETH Zurich.

6. Training PhD students for transferable or professional development skills

The majority of universities provide formalized professional development courses, which can involve PhD training on presentation skills, report writing in English, laboratory safety, and assertiveness training. In certain universities there are specific university-wide doctoral programs providing this training, for example the University of Zurich's Graduate campus, for PhDs and postdocs [6].

The NCCR MUST program provided an opportunity to create specialist scientific provision and also professional development courses for PhDs in a network of eight Swiss universities. The concrete measures for doctoral training have been concentrated in an Annual Meeting with expert tutorial speakers, which also gives young scientists a place to communicate their research results to a wider community through presentations and poster sessions. Alongside there are outreach projects designed to develop PhDs' experiences in interacting with the public

and schools, thus building concrete career experience beyond the laboratory. PhD students have also organized well-attended summer/winter schools in specialist aspects of science, which were attended and supported by professors in the network. A future plan is to develop a specialist writing course for PhDs in physics and chemistry, working on both the general aspects of writing and the specific needs of the two disciplines.

The program to recruit, retain, and promote the women scientists in the network resulted in the design and running of a number of training skills workshops: managing your supervisor, finding a mentor, presentations skills, introduction to negotiation skills in a scientific environment, and the preparation of grant applications. A number of these workshops were held in a mixed gender setting, whilst others were women only. There are also regular career workshops, with experienced female scientists as role models, including professors at different stages of the career, and women who have moved into industrial careers.

7. Outlook

A new PhD student embedded within a group over the four years of a doctorate, particularly in fields such as experimental physics, has the opportunity to develop a range of independent skills, including a regular interaction with industrial firms, other academic groups, networks and the public. The development of independent thinking necessary for a successful PhD stands them in good stead, regardless of the subsequent career choices, which from this group range from positions in consultancy, banks, the optical and photonics industry, to new positions in academia.

However, given the scarcity of academic positions in general, it is clear that the majority of PhD students will move out of academia. It became a growing concern in the last decades, that doctoral training did not give a sufficient breadth of skills for the majority of PhD students moving into a wider economic sphere. This led to a European-wide move towards creating doctoral training schools or initiatives across all research fields [1, 2]. The establishment of these initiatives acknowledged the need for more formalized professional development training for all doctoral candidates; the "transferable skills", which will benefit them as they move into other sectors. This more formalized doctoral training aims to maintain research excellence in research groups, whilst giving independent training support to young researchers working within those groups.

In this context, it is important to remember that conducting cutting-edge and excellent research is the responsibility of the universities and the professors, and that the learning developed in the research process is also central to a PhD. Young people benefit from the opportunity of taking part in the creativity, challenges and uncertainty of the research process in itself. As we look to improve PhD supervision, and also formalize transferable skills training, we need to start from this premise. Different research disciplines present their PhD candidates with contrasting learning experiences and needs, which means that good supervision may have specific characteristics across diverse research fields.

In many European universities the responsibility for producing a successful, rounded PhD candidate, does not lie solely on the professor's shoulders, and is the result of a partnership with formalized professional development providers and doctoral initiatives. However, we must not undervalue the vital impact of conducting world-leading research, the excitement of being involved in this process, and the skills learned by the PhD student as a result.
World-leading universities, with their internationally recognized professors will provide a doctoral experience that is excellent for the PhD student embedded in their research group, whilst working in partnership with doctoral training initiatives that provide them with additional transferable skills for the next steps of their career. ■

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Digitale Bildung im Doktorat

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Das Thema digitale Bildung gilt als neue Herausforderung der Hochschulen. Dabei stellt sich die Frage, was digitale Bildung charakterisiert und was sich davon in Studienprogrammen umsetzen lässt. Der folgende Beitrag beschäftigt sich insbesondere mit dem Stellenwert des Doktorats im neuen digitalen Bildungsparadigma.

1. Was bedeutet digitale Bildung?

Die Digitalisierung verändert unsere Wirtschafts- und Arbeitswelt rasch und tiefgreifend. Ihre technologischen Innovationen haben das Bildungswesen schon längst erreicht: Interaktive Veranstaltungen, «*Blended Learning*» oder «*Massive Open Online Courses*» (MOOCs) sind nur einige Beispiele dafür. Sieht man dies bereits als gelungene Umsetzung digitaler Bildung, reduziert man den Begriff zu sehr auf den Einsatz digitaler Technologien und differenziert ungenügend zwischen einer Medialisierung des Unterrichts und der digitalen Bildung als Einheit [1, 136]. Zahlreiche Diskussionen und Umsetzungsversuche verlaufen bisher ausgesprochen und allzu einseitig rein technikorientiert [2, 20].

Das Ziel von Bildung – auch von digitaler Bildung – ist angesichts der Digitalisierung gerade nicht der massive Technologieeinsatz, sondern nach wie vor «die Weiterentwicklung von Fähigkeiten aller Beteiligten unter Berücksichtigung ihrer individuellen Leistungsvoraussetzungen unter Einsatz didaktisch sinnvoller Methoden und Technologien» [3, 12]. Die Technologie bleibt «nur» ein Hilfsmittel, auch für die digitale Bildung. Trotzdem stellt sie auch Anforderungen: Bildung braucht adäquate Inhalte und Konzepte für den Einsatz der Technologie [4, 178]. Die Didaktik führt die Technologie und nicht umgekehrt [5, 16].

Um dabei eine Qualität zu erreichen, die keine Verbindung zum Lemma «Qual» aufzeigt, ist ein Umdenken erforderlich. Dabei liegt der Schwerpunkt nicht nur etwa im Data-Mining, der softwaregestützten Auswertung von Lerntätigkeit der Studierenden oder der Unterstützung anhand technologischer Hilfsmittel. Digitale Bildung kann auch nicht primär als Einflussnahme von global agierenden Superkonzernen auf die Erziehung und Bildung verstanden werden, etwa weil diese sie als neues Geschäftsfeld entdecken [2, 163].

Digitale Bildung umfasst primär das Handlungsfeld der Erfüllung der nachfolgend geschilderten, ausgewählten grundlegenden Herausforderungen, deren Bedeutung angesichts der fortschreitenden Digitalisierung erheblich gestiegen ist. So kann digitale Bildung ihren Auftrag erfüllen: Sinnvolle und benötigte Qualifikationen für eine digitalisierte Lebens- und Arbeitswelt vermitteln.

2. Kompetenzen in der digitalen Forschungs- und Arbeitswelt

Eine Reihe von Studien zeigt die zukünftig erforderlichen Kompetenzen vereinzelt auf [2]. Einige Kompetenzbereiche stellen sich als zentral für das 21. Jahrhunderts dar:

- Selbstgesteuertes und eigenverantwortliches Arbeiten sowie unternehmerisches Denken,
- Teamfähigkeit, Kooperation und Vernetzung mit anderen sowie Führungsstärke insbesondere in virtuellen Arbeitsumgebungen,
- Fähigkeit, Informationen und Daten zu recherchieren, zu analysieren, zu interpretieren sowie kritisch zu hinterfragen,
- kritisches und lösungsorientiertes Denken; die Fähigkeit zur Analyse und Interpretation und zur interdisziplinären Vernetzung von Wissen und Informationen,
- wissenschaftliches Denken und die Anwendung von wissenschaftlichen Methoden,
- Verständnis für ethische, soziale, gesellschaftliche, ökologische, kulturelle, humanitäre, wissenschaftliche und wirtschaftliche Zusammenhänge.

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Für die digitale Bildung haben vor allem die Analyse, Interpretation und Vernetzung von Daten bzw. Informationen einen herausragenden Stellenwert. Von Absolvierenden werden mitunter nicht völlig neue Kompetenzen gefordert, die bezeichneten gewinnen jedoch an Bedeutung und Tiefe [5], ganz besonders mit Blick auf das Doktorat.

Der Europäische Qualifikationsrahmens für lebenslanges Lernen (EQR) [6] unterscheidet bewusst die jeweils erforderlichen Kenntnisse, Fertigkeiten und Kompetenzen für Bachelor, Master und Doktorat. Für das Doktorat werden ausgesprochen fortgeschrittene Fertigkeiten und Spitzenkenntnisse und explizit sogar Innovationsfähigkeit gefordert. Wissenschaftliche und berufliche Integrität und nachhaltiges Engagement werden gleichermassen verlangt. Damit sind für das Doktorat hohe Standards definiert. Sie gilt es einer Überprüfung standhaltend zu belegen.

Die digitale Bildung erfordert jedoch weitere, über den Qualifikationsrahmen des EQR hinausgehende Kompetenzen. Gleichwohl bleiben die klassischen Zielsetzungen eines Doktorats – die individuelle Persönlichkeitsentwicklung und die Persönlichkeitsentfaltung – zentrale Forderungen. Im Idealfall bringt jedes Individuum seine Kompetenzen möglichst selbstgesteuert in eine problemlösende Teamarbeit innerhalb einer arbeitsteilig organisierten Gesellschaft ein [7]. Das Doktorat beispielsweise unterstützt diese Zielsetzung, indem die Kandidaten dazu befähigt werden, sich innerhalb praxisnaher Projekte intensiv mit einem Thema auseinanderzusetzen, ihre Stärken zu erfahren und Grenzen kennenzulernen. Dies geschieht in einer Tiefe, welche Selbstständigkeit voraussetzt und fördert und schliesslich die Verteidigung der gewonnenen Erkenntnisse und des geschaffenen Mehrwerts erfordert.

Forschungsvorhaben innerhalb eines Doktorates sind meist teamgebunden, sei es in der Teamgemeinschaft mit den Betreuenden oder innerhalb der gesamten Science Community. Die dafür erforderliche Vernetzungsfähigkeit und Sozialkompetenz erlangen so einen nicht unwesentlichen Einfluss auf die fachlichen Qualitäten. Ausserhalb der Scientific Community gewinnt der Faktor der Vernetzung an Bedeutung, je komplexer die Strukturen der digitalen Gesellschaft werden [4, 94]. Doktoranden von heute werden hierzu jedoch durch Kolloquien, thematische Plattformen sowie Teilnahme an Tagungen, Veranstaltungen usw. gezielt befähigt. Zudem ist ein mehrjähriges Forschungsvorhaben, in dem der Doktorierende nicht nur methodisch und fachlich reift, eine ausgezeichnete Werkstatt der Persönlichkeitsentwicklung und -entfaltung. Die Doktorierenden schaffen sich ein Netzwerk mit engeren und lockereren Verbindungen, in Hochschulen wie in Unternehmen. So zeigt Granovetter in seinem Werk *«The Strength of Weak Ties»*, dass für den (beruflichen) Erfolg vor allem die persönlichen Verbindungen, auch lockere, entscheidend sind (siehe z.B. [3, 95]).

Die digitale Arbeitsgesellschaft fordert – ebenso wie ihre Vorläufer – aber noch andere Fähigkeiten, wie Selbstständigkeit, fokussierte Auffassungsgabe und hohe Transformationsfähigkeit. Aktuelle Studien belegen, dass unsere Kinder als Berufstätige zwischen zehn- und vierzehnmal Ihren Arbeitsplatz wechseln werden [8, 64]. Doktorierende sind betreffend Selbstständigkeit, Auffassungsgabe und Transformationsfähigkeit sehr versiert. Während das «Kleinkind» Bachelor noch über die Strasse geführt wird, achtet man beim «Heranwachsenden» Master auf mehr Selbstständigkeit, so dass die Strasse nur noch unter Aufsicht überquert wird und auch alternative Routen erlaubt sind. Der Doktorand muss seinen Weg hingegen selbst finden – er bekommt nur noch Empfehlungen mit auf denselben. Er oder sie wird nicht zwingend den kürzesten oder leichtesten Weg finden, aber all das steigert die Wahrscheinlichkeit, dass er oder sie als reifer Erwachsener den eigenen Weg und den richtigen Weg für die Wirtschaft und Forschung findet. Dieser Reifeprozess ist nicht immer schmerzlos. Manche Doktorierende fühlen sich geradezu «im Stich gelassen». Doch die Aufgabe der Betreuenden ist auf eine Weichenstellung reduziert, die die Doktorierenden befähigt, den richtigen Weg zu finden, zu gehen und wo nötig Sachverhalte zu transformieren.

Lernen ist dennoch ein sozialer Prozess, der stark von zwischenmenschlichen Beziehungen geprägt ist [4, 91]. Eine besondere Stellung hat dabei die zur verantwortlichen Betreuungsperson. Mittlerweile kommen auch mehrere Betreuende vor. Vor allem die Hattie-Studie hat gezeigt, dass die Betreuenden einen wesentlichen Einfluss auf den Erfolg haben [4, 70]. Zentral dabei ist das Konzept der Selbstaktualisierung nach Rogers – das positive Streben des Menschen, die individuellen Veranlagungen bestmöglich zu nutzen [2, 68].

Die Forderungen der digitalen Bildung gehen jedoch noch einen Schritt weiter. Erst wenn es dem Doktorierenden und dem Betreuenden gelingt, eine soziale und kognitive Vernetzung des Doktorierenden zu erreichen, spricht man vom «Lernen 4.0» [10, 36]. Das Doktorat ist der ideale Nährboden dafür. Durch die unabdingbare enge Zusammenarbeit kommt der Leitsatz: «*In order to teach John, you must get to know John*» [4, 24] zum Tragen. Digitales Lernen bedeutet in den bestehenden Beziehungen nicht, das Lernen ausschliesslich in die Hände des Lernenden

zu geben oder das gesprochene Wort durch digitalen Austausch zu ersetzen, sondern es in seiner Tiefe und Nachhaltigkeit positiv zu beeinflussen [2, 168].

Dazu bedarf es aufgrund der mitunter engen Zusammenarbeit neben einer fachlichen auch einer sozialen Kompatibilität zwischen den Beteiligten, der manchmal zu wenig Gewicht beigemessen wird. In einigen Doktoratsprogrammen ist daher das Kennenlernen des Gegenübers, ein vorangehender Austausch über die Arbeitsweise und Paradigmen der geplanten Zusammenarbeit vor der Entscheidung für ein Doktorat verpflichtend. Das reduziert Überraschungen, die sonst erst später (und damit zu spät) aus der fachlichen und/oder sozialen Inkompatibilität der Betroffenen erwachsen könnten. Dieses Vorgehen reduziert ebenso den sonst übermässig wirkenden Zwang zur «friedlichen Koexistenz», der bei divergierenden Anforderungen bzw. Erwartungshaltungen letztlich die Arbeitsqualität beeinträchtigt.

Ist die grundlegende Befähigung gegeben, erlauben Doktoratsprogramme mit digitaler Bildung erstaunliche Entwicklungen. In einigen Programmen werden die Studierenden gezielt gefördert, indem von ihnen an Umfang und Qualität zunehmende Publikationen gefordert werden. Unterstützung erhalten sie durch das Team, die Betreuenden ebenso wie durch Kolloquien und das in der digitalen Lehre wiederentdeckte «*Peergrading*». Diese Beurteilungszirkel können weiteren Entwicklungsbedarf aufzeigen. Die Doktorierenden erweitern zudem ihre sozialen Fähigkeiten, denn in der zukünftigen digitalen Arbeitsgesellschaft in Wirtschaft und Forschung hat der Einzelkämpfer weitgehend ausgedient [2,85].

3. Die neuen Rollen von Lehrenden und Studierenden

Digitale Bildung ersetzt Lehrende nicht, sondern erfordert ein neues Rollenverständnis. Mittels Data-Mining und Technologien zur Bewältigung von «*Big Data*» können Lehrende eine wesentlich grössere Zahl von Studierenden individuell und unter Beachtung ihrer individuellen Leistungsvoraussetzungen betreuen [2, 168]. In der digitalen Bildung ist es die Aufgabe der Lehrenden und der Betreuenden, kreative Lernprozesse zu initiieren, den Lernenden Möglichkeitsräume für selbstgesteuertes, vernetztes und kollaboratives Lernen zu öffnen, Erfahrungsräume zu schaffen und Hilfe zur Selbsthilfe zu erlauben [2, 85].

Im Rahmen der digitalen Bildung werden Hochschule und Studienprogramme zu einem Redaktions- und Werkstattraum [2, 172] und damit zu einem «*Makerspace*» ebenso wie zu einem «*Thinktank*». Was für manche anderen Studienprogramme noch wie Zukunftsmusik klingt, ist für das Doktorat bereits Realität und Notwendigkeit. Die Lernenden produzieren Inhalte für andere Lernende, für die Wirtschaft, für Kollegen, und sie treiben «*Open Education*» und «*Open Science*» auf unterschiedlichen Niveaus und Wissensständen voran.

Wie jede Ausbildung beinhaltet aber auch diese höchste Stufe der akademischen Qualifikation vor dem Erreichen der forscherischen Selbstständigkeit Tätigkeiten und Aufgaben, die dem einzelnen Doktorierenden sicherlich schwerer oder leichter fallen mögen, insgesamt aber zur Kompetenzentwicklung und Reifung der Persönlichkeit beitragen. Was ungerechterweise als moderne Sklaverei der Doktorierenden bezeichnet wird, ist nichts anderes als ihre Möglichkeit, innerhalb des Fachgebiets Erfahrungen zu sammeln und Entwicklungsräume zu entdecken. Dabei ist unbestritten, dass Doktorierende eine wertvolle Stütze der Forschung und Lehre sind und zu einer Verjüngung der Lehrmethodik beitragen. Es braucht diesen Nachwuchs, denn ein Generationenwechsel der Beteiligten in Bildung, Forschung und Wirtschaft muss gewährleistet bleiben.

4. Individualität der digitalen Bildung und die Herausforderung der Heterogenität

Lernen ist eine Existenzform des Menschen und daher ein selbstgesteuerter, strukturdeterminierter Prozess. Ein solcher benötigt eine unterstützende, nicht-direktive Didaktik, eine «Unterstützung auf Wunsch» beim Aufbau von Wissensnetzen [3; 4,60]. Zylka bezeichnet den Lehrenden in seinem erweiterten Tun als Beziehungsbeschaffer, Hüter der Zielerreichung und Förderer [8]. Dazu bedarf es einer individuellen Kompetenzorientierung, was wohl die grösste Herausforderung für die Hochschulen im Zuge des digitalen Lehrens und Lernens darstellt [1, 4, 9, 10]. «*One size fits all*» passt jetzt nicht mehr: Digitales Lernen bedeutet, das Vorwissen und die Vorerfahrungen des Lernenden zu erheben und mittels digitaler Möglichkeiten eine individuelle Weiterentwicklung der Kompetenzen zu ermöglichen.

Dies bedeutet weder, dass keine Kompetenzen vorausgesetzt werden dürfen, noch dass alle Studierenden automatisch zu einem akademischen Grad geführt werden. Diejenigen jedoch, die das Potenzial aufweisen, werden innerhalb der digitalen Lehre individuell unterstützt und entwickelt. Das in der digitalen Bildung geforderte personalisierte Studium wird nicht nur in Stanford und Oxford, sondern auch an anerkannten Schweizer Hochschulen praktiziert.

Im Sinn einer positiven Pädagogik werden Stärken individuell gefördert und Schwächen aufgegriffen. Je

höher die Ausbildungsstufe, umso mehr sind Freiheit und Selbstständigkeit der Studierenden notwendig. Das Erkennen und Nutzen der eigenen Stärken löst dann eine Art Schaffensrausch aus. Damit gehen eine hohe Zufriedenheit, Lust an der eigenen Tätigkeit und eine intensive Lernerfahrung einher, das Engagement steigt [2, 61]. Entsprechend der Ausbildungsstufe zeigt kein Programm mehr Freiheitsgrade und Möglichkeit zur selbstständigen Arbeitsweise als das Doktorat.

Fragt man Lehrende heute nach Ihrer grössten Herausforderung, so nennen sie oft die Heterogenität [4, 60]. Unterschiedlichkeit wird von vielen als Problem empfunden. Dahinter verbirgt sich sicher auch der Wunsch nach einer leistungshomogenen Gruppe, was bedeutet, die Stärksten und Schwächsten auszusortieren. In der digitalen Bildung wird hier ein Umdenken gefordert, denn hier ist es unabdingbar, die Vielfalt der Persönlichkeiten als Chance zu begreifen und den Bildungsprozess für alle zugelassenen Studierenden mittels technologischer und didaktischer Hilfsmittel offen und individuell zu gestalten [2, 64]. Um dabei verschiedene Richtungen zu fördern, haben beispielweise Universitäten in Grossbritannien unterschiedliche Formen des Doktorats, den PhD und den DBA, eingeführt.

Eine bereits seitens der Wirtschaft und durch die digitale Bildung zusätzlich unterstützte Forderung ist die des Praxisbezugs der Ausbildung. Ein bekannter und in der digitalen Bildung an Bedeutung gewinnender Leitsatz ist «*Learning by doing has more conditions for success than teaching by telling.*» [4, 80]. Entsprechend hat das «Broadcast-Learning», bei dem eine Person allen Teilnehmenden das Gleiche mitteilt, zwar nicht völlig ausgedient, wird künftig aber nur noch einen Teil des Bildungsvorgangs abdecken. In der digitalen Bildung steht das Erleben des Gelernten auf unterschiedlichen Kanälen im Vordergrund. Doktorate sind dabei lange nicht so praxisfern, wie gern behauptet wird – allein schon deshalb, da viele Promotionsstellen an Wirtschaftsprojekte gebunden sind und individuelle Förderung somit möglich ist.

In kaum einem anderen Programm werden Studierende so individuell und praxisnah gefördert wie innerhalb von Doktoratsprogrammen, die drei oder mehr Jahre dauern. Das alles bedeutet jedoch zusätzlichen Aufwand für die Betreuenden. Auch wenn Doktoranden im Sinne einer ganzheitlichen Bildung auch für angrenzende Tätigkeiten eingesetzt werden, so kompensiert dies nicht den Aufwand. Die Unterstützung der Forschungstätigkeiten durch die Politik, die Wirtschaft und die Förderinstitutionen wie auch die Passion des Betreuenden sind für die Ausbildung von Doktorierenden kumulativ notwendig. Besonders schwierig gestaltet sich die Promotion in der nebenberuflichen Form, da hier ein vollwertiger Einsatz der Doktorierenden in angrenzenden Tätigkeiten nicht möglich ist. Digitale Bildung macht aber keinen Unterschied zwischen Voll- und Teilzeitstudium.

5. Fazit: Stand der digitalen Bildung an den Hochschulen der Schweiz

Der Erfolg der digitalen Bildung hängt nicht von der Verfügbarkeit neuester digitaler Technologie ab.

Eine Herausforderung wird darin bestehen, die Akzeptanz für offene Bildung zu den Akteuren zu tragen [1, 149]. Offene Bildung bedeutet, dass Bildungsinhalte jedem und das möglichst jederzeit zur Verfügung stehen und dass auch Lehrmaterialien unter den Dozierenden offen zum Austausch zur Verfügung stehen. Des Weiteren bedarf es der Kompetenzentwicklung aller Beteiligten [9, 51]. Die dafür notwendigen Entwicklungsprozesse sind schmerzhaft und aufwändig [4, 105]. Es braucht insbesondere eine Transparenz der diesbezüglichen Angebote, denn selbst die beste Bildung, unter Einbindung aller digitalen Kompetenzen zugeschnitten auf individuelle Bedürfnisse, genügt nicht, wenn das Angebot nicht transparent und unauffindbar ist [4, 181].

Digitale Bildung verlangt Mut, innovatives Denken und Gründerkultur [4,181]. Für ihre Verbreitung sind Anreizsysteme und die Überwindung von Vorurteilen nötig. Zur Integration der digitalen Bildung braucht es Zeit und auch den Raum, Fehler zu machen, es braucht Erfahrungen und Erkenntnisgewinn [2, 136]. Auch an den Hochschulen wird es die Digitalisierung nicht zum Nulltarif geben.

Die digitale Bildung verlangt neben fachlichen auch soziale und insbesondere mehr methodische Kompetenzen im Sinne einer ganzheitlichen Bildung. Es stellt sich hierbei nicht die Frage, ob durch die digitale Bildung klassische Formen abgelöst werden, denn sie eröffnet die Chance zu einer ungekannt vielfältigen Ausdifferenzierung des Angebots. Das wiederum erfordert eine umfangreichere und erweiterte Begleitung, auch wenn diese digital unterstützt wird [1, 99]. Das Ziel ist die individuelle Kompetenzorientierung, ermöglicht und unterstützt durch digitale Technologien.

Bestehende Doktoratsprogramme zeigen bereits heute sehr gute Ansätze zur Umsetzung digitaler Bildung. Nahezu kein anderes Studienprogramm entspricht dem Idealbild einer digital geprägten, multioptionalen Bildung so sehr wie ausgewählte Doktoratsprogramme. Mitunter wird dennoch einiges falsch verstanden und kritisiert. Keineswegs sind diese Doktoratsprogramme fehlerfrei. Nicht jedes

Programm eignet sich für jeden Studierenden und jeden Betreuenden.

Vor allem aber dürfen sich die Anbieter von Doktoratsprogrammen jetzt nicht ausruhen. Denn die reinste Form des Wahnsinns, wie Einstein einmal zitiert wurde, ist, alles beim Alten zu belassen und zu hoffen, dass sich etwas ändert [4]. Nimmt man die sich abzeichnende digitale Bildungsrevolution vorweg, werden also Hochschulen, die Studierende nach dem Paradigma der industriellen Massenproduktion «bilden», ihren Auftrag in der Lehre nicht mehr erfüllen [2, 164]. ■

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Successful supervision of PhD candidates – a privilege, a challenge and a noble task!

Helke Hillebrand*

Much has been and is being said about especially unsuccessful supervision – flaws, neglect, misconduct, power games and a wealth of many other facets of inacceptable human behavior lead the long list of failed interactions. This article aims to shed light on aspects of successful interactions and how both parties – the supervisor and the supervisee – will benefit from a fruitful, conscious and professional yet close relationship.

1. How to define "successful"?

Postulate No.1. *Successful supervision tends to happen outside of one's comfort zones*

Successful supervision throughout the PhD research phase will bring about an attitude of lifelong learning. However, while it happens, successful supervision is not necessarily identical to what is perceived as likeable by the PhD candidate – nor even by the supervisor in his/her role as a mentor. Supervision is hard work and does not simply happen in passing. It is an act of conscious interaction towards jointly reaching a shared goal. And this goal comes with two features of almost equal relevance: while PhD research is expected to establish new scientific, scholarly insights in the world surrounding us it is also meant to conclude the formation of an ambitious, well-trained and rather unexperienced colleague towards becoming an independent scientist. Achievement of both aspects is measured by means of a snapshot at the turning point from student to scholar.

However, in my eyes successful mentoring of a PhD student has a much broader scope. It is the noble task of mentoring a talented, aspiring, intellectual mind towards critical thinking, resilience, pleasant self-confidence, leadership, courage and intellectual risk-taking, high ethical standards in science and society, societal awareness and a sense of responsibility to share and contribute for the benefit of furthering our knowledge-based societal development.

Successful mentoring thus becomes mostly visible in the (long term) performance of the mentee in terms of employability, career development over time and his/her capacity to contribute ideas and solutions and to set new standards in science and society. In this context it is important to stress that employability and career development refer in equal measure to positions in academia, the private sector and the public domain for all areas of science & technology, of politics, business & administration, of the arts & humanities.

None of the aforementioned more global qualifiers for successful supervision and mentorship can be measured with grades, publication output, patents, or any excel lists with tick boxes and the like, nor do they become clearly defined and transparent at the end of a three to four years PhD research period. On the contrary, successful supervision and mentorship are revealed by carefully following the candidates throughout their PhDs in terms of fostering intellectual and personal growth, the step-by-step development of a well-balanced portfolio of (vocational) skills and an attitude of integrity through well grounded, regular and careful feed-back. Thus, supervision is at times demanding, disappointing and even unappreciated and often challenges a supervising mentor's own limits and comfort zone. Thus, high quality supervision needs to be seen as an art that requires continuous personal growth and lifelong learning on the supervisor's part and involves

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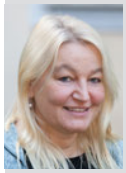

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a conscious learning-by-doing approach complemented with meaningful coaching and course work. Consequently, excellence in supervision aimed at "releasing" well trained PhDs necessitates excellent supervisors and they deserve training, support and recognition for this aspect of their work.

2. How to prepare for and foster successful supervision?

Postulate No. 2. *Excellence in supervision can be learned, requires experience and merits recognition.*

Aspiring as well as experienced supervisors are usually highly qualified, ambitious and time-constrained hard-working individuals. Thus, a meaningful infrastructure for providing support to supervisors and supervisees needs to offer a broad range of formats to allow for effective, efficient and customized input towards improving the supervision experience on both sides. Most favorably, a portfolio of different training formats includes (1) train-the-trainers initiatives, (2) dedicated training for PhD candidates and (3) in a best case scenario also the option for trainings for supervisor-supervisee tandems. Contentwise, such a portfolio is required to cover a set of basic and advanced conflict prevention and resolution tools, including the availability of a transparent list of contacts in cases of conflicts, and a catalogue of clear procedures for conflict settlement in the event of failure of all informal methods for the remediation of a difficult situation. On the institutional end, an atmosphere that fosters communication and encourages or even demands interaction among peers on a given career stage as well as among individuals or groups at different career stages is indispensable.

2.1. Train-the-trainers initiatives

Postulate No. 3. *Trainings need to be short, modular and effective.*

When talking about the necessity of providing training for the trainers I am explicitly not referring to any standard, pre-fabricated, theoretical training that is often deemed boring. Across the board, PhD supervisors are very intelligent, busy people with a broad range of interests, and excellence in supervision is only one task among many. Thus, trainings need to be short, modular and effective. Any time spent on reflecting about supervision practices needs to provide an immediate return on investment that is an added value for dealing with daily life and routines. A successful format along these lines is a coaching approach – either individually or, depending on the topic, also in small groups, aiming at a better understanding of one's own motivations, weaknesses, and the triggers governing one's behaviors. With a better insight into the origin of tiny daily annoyances it is easier to become more time-effective and to thus free-up quality time for supervision.

Generally, trainings should be voluntary (except perhaps for a very basic, first short course), otherwise it will be a waste of time for the trainer, for the involuntary participant and for those participants who chose to join in. In a most favorable scenario one would be able to work with a community of willing participants in order to set the stage for those who are more reluctant.

Achieving excellence in supervision requires a certain level of sophistication in terms of communication skills. This pertains especially to the art of giving feed-back in a productive, trustworthy and palpable way. In order to avoid working with standard phrases and communication recipes the acquisition of *brainsmart*[1] communication and leadership skills as well as a deepened insight into the impact of neuro-linguistics on the speaker and the recipient provides a sustainable means of raising supervisory, mentoring and teaching skills to the next level. In addition to these suggestions for a more formal training experience, peer mentoring and coaching, especially by more experienced colleagues for aspiring, less experienced colleagues, is an invaluable asset towards fostering a broad understanding of the features and values of excellence in supervising PhD candidates and other early career stage co-workers in general. In this context it is worth mentioning that the most junior colleagues, who are at the challenging turning point, morphing from Postdoc and single-contributor to supervisor and team leader, are often given a huge amount of freedom to build their own research profiles and supervise PhD candidates from a very early stage. However, there is only a fine line between freedom and neglect, and a lack of mentoring for colleagues who are yet to grow in their new roles may lead to the most painful supervisory experiences for the PhD candidate and the supervisor alike.

Postulate No. 4. *The success of supervision increases with the right match between supervisor and supervisee.*

Gaining insight into the latest research on the art of hiring people is another valuable aspect of training that contributes to avoiding disappointment in PhD supervisor/candidate relationships. A thoroughly prepared and well-conducted interview procedure

[1] The term "brainsmart" was coined in the early 2000s by Donna Wilson and Marcus Conyers. Anette Prehn developed the principles into her *Framestorm*[R] method, which "is a systematic brainstorm at the level of interpretation and mindset. It invites the Framestormer to reframe, i.e. reinterpret, a challenging situation." https://brainsmart.today/ (3 October 2018)

favorably including the opinion of peers in the field prior to hiring a PhD candidate is known to deliver a high return of investment in the long run. Furthermore, when identifying future PhD candidates, it is highly recommended to put emphasis on the potential for growth rather than to simply assess the ostensible academic achievements to date.

Significant research has been done into understanding universal, acquired stereotypes as a basis for accidental behavior that influences conduct and decision-making. The findings are broadly applied towards a better understanding of the prerequisites for accomplishing competency-based recruitment and for avoiding unconscious (implicit) bias[2] in an interview situation. The trouble with unconscious stereotyping is that all of our brains without exception are set up to perfect filtering[3] and to help us to process a massive daily influx of information. Thus, everybody would benefit from the reframing of his/her implicit prejudices in order to ameliorate recruitment outcomes. If in doubt about this, it is a good idea to take the popular and well-respected Harvard Implicit Bias Test[4].

2.2. Dedicated training for PhD candidates

Postulate No. 5. *Mind the gap – PhD candidates are novices in academic customs.*

Incoming PhD candidates face a lot of challenges during their first few months in their new role. Morphing from a student into a PhD researcher is a big shift and the success factors that allowed the PhD candidates to be high performers in previous settings and throughout their past learning experiences will most likely undergo a great change. During their time as students, they will also have been used to being among the best of their cohort; however, now a new bell curve of high performers is about to establish itself again. Thus, for the first time, many talented candidates will find themselves in a different position within this bell curve and this is hard to digest. Simultaneously, starting the PhD research phase with a dedicated supervisor means building – most likely also for the first time in their lives – a proper professional relationship with the supervisor. A supervisor is neither a friend nor a relative nor an employer in the classical sense, but is still a person with whom the PhD candidate has a close relationship. Therefore, at the beginning of the PhD, it is necessary to learn how to balance proximity and distance within a professional relationship and it is meaningful to create mutual awareness about the supervisor's and the PhD candidate's views, needs and expectations. Mentoring networks in which experienced PhD candidates support the incoming ones have proven successful in many places – as long as they remain voluntary. In addition to the creation of informal networking opportunities formal training modules covering aspects of communication skills, conflict management skills and some understanding of personality types and compatibility traits can be of great help in boosting a PhD candidate's appreciation for what being a PhD candidate may mean for the supervisor and what kind of expectations are connected to this new career-step. Ultimately, the aim of such early trainings boils down to satisfying a need for mutual understanding between the supervisor and the PhD candidate in terms of their needs, expectations and limitations.

Such fundamental early training opportunities are also a good moment in time for a higher education or research institution to advertise for its identity and implement its relevant corporate values. The onboarding process[5] as such has been identified as a decisive element in the successful integration of new colleagues not only in the private domain but increasingly also at universities and research organizations with respect to their structured PhD programs, graduate schools and graduate academies.

2.3. Tandem Training

Tandem training for a supervisor and a supervisee is the most explorative, adventurous and intensive format for establishing transparent expectations and managing interactions between individuals working closely together in a professional relationship. It is a regular component of continuous professional development especially in clinical settings, and is frequently offered as a more formal training opportunity to leadership in the private sector in order to foster effective and efficient collaboration between leaders and their closest co-workers. Classically, tandem trainings are composed of sessions designed exclusively for the leaders/supervisors, parallel sessions for the co-workers/supervisees, joint sessions for both and training opportunities for each individual tandem. Tandem trainings have their role in setting up new teams as much as in improving or curing difficult relationships. In an academic setting participation will only be successful if it remains voluntary for both parties of a tandem but it can set a great example for what strong teams are all about. Presum-

2 Bartlett, Christopher A.; Ghoshal, Sumantra: Building competitive advantage through people. *MIT Sloan Management Review* 43, 2, (2002): pp. 34.

3 McNutt, Marcia: Implicit bias. *Science* 352, 6289, (2016): pp. 1035.

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5 Bauer, T. N. (2013): Onboarding: Maximizing role clarity and confidence. Part 2 of the 3 part Success Factors Onboarding White Paper Series. *http://www.successfactors.com/en_us/resources.html/* (3 October 2018)

ably, participants may easily become great ambassadors for peers and amplifiers among their cohorts for what they gained during their shared exercise.

Postulate No. 6. *Great achievements merit recognition.*
Awards for outstanding PhD theses are quite common; awards for outstanding supervisors are becoming more popular, training awards for those who are proactively embarking on improving their supervision and mentoring skills are almost non-existent. While much is done in terms of supervision prizes – more could be done in terms of honoring supervisory track records when it comes to career progression and the awarding of grants including fellowships/positions for PhD candidates and junior Postdocs to more experienced faculty.

Postulate No. 7. *Reinforce the value of leadership skills throughout career progression.*
Career progression is a challenging experience at all levels. And while climbing up the hierarchical ladder and enjoying an ever growing reputation in the academic community is generally considered to be positive, it often goes unrealized that such progress has an impact on one's personality. Ample research literature is available depicting the major changes in personality traits that occur when growing into more senior roles throughout a career. For example, the Myers-Briggs Type Indicator (MBTI) Test may generate very different results when taken as a PhD student or later as a junior group leader or much later as a PI. And this is not a weakness of this renowned test but the result of increased experiences, changing priorities and emerging perspectives. At the same time the next generations of supervisees regularly undergo serious changes in their generational identity – just to mention the suite of generations X (born 1965–1980), Y (born 1980–2000) and Z (born 2000–2015)[6]. Evidently, the expectations of the individuals representing a given generation have been shifting significantly over the decades and, as a result, the requirements for doing well as a supervisor, mentor and leader have also undergone quite an evolution. Consequently, excellence in supervision is a moving target and deserves careful nurturing throughout a career.

Postulate No. 8. *The right to supervise needs to be merited – continuously!*
In most academic settings the right to teach and to supervise PhD students is conferred once at a relatively early career stage. After this right has been granted to a new supervisor and mentor it usually is never monitored and the leader is left alone with respect to future performance as a supervisor and mentor. While the above mentioned training opportunities are to be encouraged and are designed to help cure the symptoms, obvious shortcomings when dealing with supervision seen among colleagues are rarely addressed and almost never prosecuted. It would be of enormous value if violations of good supervision standards triggered follow-up action, led to a (temporary) loss of the right to supervise and necessitated redeeming this right through a tailor-made coaching program. Nothing is more detrimental to the attitude of an aspiring scientist regarding his/her esteem of supervisory efforts than a lack of sanctions towards supervisory misconduct by peers and superiors. Furthermore, it would be extremely beneficial if the talent for human interaction were made part of the qualification requirements in hiring procedures. In the long run, in order to create space and equality for all kinds of personalities to participate in the research arena it would be helpful to allow for posts as team leaders as well as for individual scientific contributors.

3. How to build and maintain a prolific, reliable, affirmative and healthy professional relationship?

Postulate No. 9. *Supervisors should not be left alone – share the burden!*
The four eye principle is widely accepted as a helpful means to ensure for factual, unbiased and fair assessment in any given context. When applied to the situation of a PhD project, the four eye principle enriches both the supervisor's and the supervisee's situation. The benefits of collegial hiring decisions as described above hold true for all steps and decisions taken throughout the further progress of the PhD project. Any type of co-supervision effort (from individual mentoring arrangements and proper dual supervision up to the implementation of thesis advisory committees including external supervisors; see also below) enriches the scientific and academic experience of the PhD candidate and provides an enhanced level of security for both supervisor and supervisee in terms of diversification of insights and opinions. The supervisor – as much as the supervisee – will benefit from the alternative views, preferences and backgrounds of the additional colleague(s) forming the supervisory tandem or team. This does not only relate to decision-making on scientific priorities and directions but also to accessing personal networks, professional experiences and different types of research culture. For any type of co-supervision approaches it is crucial that one main supervisor is designated as the first point of contact and assumes the respon-

6 Wikipedia (*https://de.wikipedia.org/wiki/Generation_Y*) (3 September 2018)

sibility for the degree-conferring process. The risk of losing momentum when the sharing of responsibilities turns into an overall lack of responsibility-taking creates too much vulnerability for young researchers who are still at the mercy of their supervisor(s) at a quite early stage of their careers. Furthermore, when setting up a supervisory tandem or team it is indispensable to avoid any situation that could potentially lead to a conflict of interest – be it scientifically, financially or personally. Thus, the choice of whether to opt solely for an additional mentor, to team-up with an internal or external second supervisor, or to go for a thesis advisory committee composed of several academic (and eventually non-academic) colleagues and experts should be made in relation to the thesis subject, the interest and career choices of the PhD candidate and the collegial network and commitments of the supervisor(s). Sharing the tasks and duties related to supervising PhD students can truly provide a safety line for the supervisor and supervisee alike – when complicated scientific and personal situations occur, when progress lags or simply when a third, independent opinion would help to reduce stress and tension.

In addition to supervisory arrangements involving more than simply the main supervisor, there are many other types of support available from colleagues who are active within any type of structured PhD program. Their support ranges from procedural assistance to help in identifying funding resources, setting up contracts for co-supervision in an (inter-) national context or coordinating contacts with ombudspersons and the like.

Supervisors are excellent at academics, but usually have limited knowledge of the "outside world"; thus, they can be approached for advice on academic careers but should not be responsible for broader career coaching or career development support. It is important to foster the PhD candidate's independence with respect to making use of the entire support infrastructure available: the supervisors need to encourage their candidates to be proactive in information gathering and networking in the academic as well the external world while the candidates have to leave their comfort zones and challenge themselves.

Postulate No. 10. *The training infrastructure has its role – but it is not the panacea.*
For the last decade(s) the debate on the *pros* and *cons* of structured PhD programs *vs*. individual PhD arrangements has delivered ample arguments in favor as much as against both forms. This dichotomy is not necessarily helpful given that there is a whole continuum of intermediate forms resulting from intelligent and creative cherry-picking in a subject–suitable manner that enriches the individual PhD experience with the most promising and helpful modular elements of structured training. Institutional support in terms of a suitable training infrastructure can have many facets ranging from dual supervisory agreements to full blown international, interdisciplinary and intersectorial thesis advisory committees all of which may be embedded in a well-structured graduate school or/and make use of the services offered by an overarching, meta-disciplinary graduate academy. The many services, facilities and broad academic contributions provided by an institutional training infrastructure account for a true enrichment of the PhD experience – and hopefully also for the supervision experience. However, at the end of the day, it is the quality of the immediate relationship between supervisor and PhD candidate in particular that is key to the success of the PhD project and that will have a significant impact on the future career of the supervisee.

Postulate No. 11. *The quality of the relationship between the supervisor and the PhD candidate is vital.*
When reflecting on the quality of the relationship between the partners in a PhD tandem, it is important to keep in mind that a close professional relationship aimed at nurturing an aspiring talented and rather unexperienced researcher towards becoming an independent, critical thinker does not equal friendship – although it may turn into such a bond at a later stage. The supervisor/supervisee relationship is an uneven one in which both partners are equally and thoroughly responsible for the success of the undertaking but also in which a critical gradient between the two proponents governs the interactions and where the PhD candidate clearly is the dependent partner in a weaker position. While this immanent imbalance of a supervisor/supervisee relationship forces the supervisor into the position of the more powerful partner, he/she is not necessarily the more creative, more astute or more inventive player but simply the more advanced one. It requires a very generous and robust personality to be able to calmly and with liberalness master such a relationship and nurture the progress of a potential future competitor.

Postulate No. 12. *Research success (and failure) is not the denominator of a researcher's value as a human being.*
Alarming publications on mental health issues among PhD candidates cover a wide range of syndromes and explanations – from being under constant pressure and feeling anxiety to clinical depres-

sion and from stress-induced sleep loss to serious forms of imposter syndrome, just to name a few. A recent study at Ghent University in Belgium[7] revealed that *"one in two PhD students experiences psychological distress; one in three is at risk of a common psychiatric disorder"*. The authors identified the working environment and the organizational settings as the "*significant predictors of PhD students' mental health*" status with conflicting expectations from all individual stakeholders culminating in "*high job demands and low job control*" being the strongest challenge. From my personal experience of having met literally hundreds of PhD candidates to date I would like to add a further observation: Personal valuation and scholarly appreciation are clearly two different items. If they are intermingled or even treated as identical, PhD candidates experience an emotional rollercoaster with serious, long-lasting negative consequences for their personal well-being and academic advancement.

4. What are the characteristics of an affirmative and healthy professional relationship?

Postulate No. 13. *The categorical imperative applies.*

In essence, any relationship requires that the partners treat each other the way they desire to be treated/to have been treated in order for it to be durable, healthy and functional. Universal ingredients for success with respect to a productive, healthy, professional yet close relationship are summarized in Table 1. A key factor for success is a respectful, comprehensible and well-balanced interplay of proximity and distance.

5. Tools for successful supervision in a nutshell

Postulate No. 14*. Avoid over-engineering, but walk the talk.*

Increased efforts towards establishing rules and regulations for the PhD research phase and defining it either as a third layer of study after the Bachelor and Masters or as the first phase in a researcher's career have led to an enriched framework of procedures and training infrastructures sustaining PhD-project related research, organization and paperwork. A lot of criticism has been brought forth about these innovations and over-engineering the PhD research phase is clearly not recommended. However, very useful tools for improved self-management throughout the PhD phase have been launched, but none of these tools will prove useful if not filled with life; none of them has any value if they remain only on paper. The two most commonly used items are briefly discussed below.

Table 1. *A recipe for success – ingredients and action towards jointly nurturing a successful supervisor/ supervisee relationship.*

Ingredients	Action
Mutual trust	Acting reliably
Respect	Active listening
Appreciation	Constructive feed-back
Clarity of expectations	Transparency
Fairness	Expectation management; consistency
Dependability	Support; avoiding competition
Feeling valued	Separating scholarly merits & personal value
Support	Availability
Academic delight	Sharing values and goals

(a) Over the past decade, supervisory agreements have become very popular as a holistic training experience for the PhD candidate and the supervisor alike in order to foster a clear definition of expectations for the successful completion of a PhD. Supervisory agreement are helpful in aligning the PhD tandem's expectations from the beginning. However, they are only worth the effort if revised regularly throughout the process.

(b) Personal research training plans are provided by many sources – either free of charge or as validated tools from professional providers. Research training plans are moving targets – in a best case scenario they set the standards for proactive life-long learning. However, they are not the only means of acquiring an attitude of life-long learning and will only work well if not prescribed and controlled by a third party.

6. Conclusion

The caring element of a prolific, reliable, affirmative and healthy professional relationship between the supervisor and the PhD candidate is often misinterpreted as overindulging the supervisee. Just to be clear on this point: High quality supervision has nothing to do with spoon-feeding. Building and maintaining a functional and productive supervision relationship throughout the PhD is simultaneously a challenge, an obligation and hard work for both of the protagonists. Nurturing an aspiring scientist's ability for autonomy, critical thinking and high ethical standards is a noble task. ■

[7] Levecque, K.; Anseel, F.; De Beuckelaer, A.; Van der Heyden, J.; Gisle, F.: Work organization and mental health problems in PhD students. *Research Policy* 46, 4, (2017): pp. 1035.

ETH zürich

Professors or Assistant Professors (Tenure Track) of Energy Science and Technology or Chemical/Process Engineering

The Department of Mechanical and Process Engineering (*www.mavt.ethz.ch*) at ETH Zurich invites applications for the above-mentioned positions.

Successful candidates must demonstrate outstanding accomplishments and future potential in an area of energy science and technology or chemical and process engineering. In addition, exceptional candidates from any field within the domain of mechanical and process/chemical engineering will also be considered. The Department of Mechanical and Process Engineering is committed to world-class interdisciplinary and cutting-edge research that spans from fundamental to applied science and from the atomic to the system scale. The new professors are expected to provide inspiration and leadership in research, contribute proactively to both undergraduate and graduate level teaching, establish an independent research profile while advising doctoral students and mentoring scientific staff, and add to the diversity of the academic community. Generally, at ETH Zurich undergraduate level courses are taught in German or English and graduate level courses in English. Successful candidates should hold a PhD or equivalent degree in mechanical engineering, process/chemical engineering or a related field at the beginning of employment.

Assistant professorships have been established to promote the careers of younger scientists. ETH Zurich implements a tenure track system equivalent to other top international universities. The level of the appointment will depend on the successful candidate's qualifications.

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Applications should include a curriculum vitae, a list of publications and projects, a statement of future research and teaching interests and a description of the three most important achievements. The letter of application should be addressed **to the President of ETH Zurich, Prof. Dr. Lino Guzzella. Submissions will be reviewed starting on 1 December 2018, but applications are welcome until the positions are filled.** ETH Zurich is an equal opportunity and family friendly employer and is responsive to the needs of dual career couples. We specifically encourage women to apply.

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Professor or Assistant Professor (Tenure Track) of Experimental Fluid Mechanics

The Department of Mechanical and Process Engineering (*www.mavt.ethz.ch*) at ETH Zurich invites applications for the above-mentioned position.

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Professors or Assistant Professors (Tenure Track) of Mechanical and Process Engineering

The Department of Mechanical and Process Engineering (*www.mavt.ethz.ch*) at ETH Zurich invites applications for the above-mentioned positions.

Successful candidates must have outstanding accomplishments and future potential in an area of mechanical and process engineering. The following topical areas or combinations thereof are of particular interest: (i) engineering mechanics: all areas including theory, numerics, experimentation and their applications, (ii) manufacturing: all related disciplines ranging from digitalisation to engineering design to additive manufacturing, advanced laser technologies and novel materials systems and (iii) digitalisation in production: all areas including the development of "smart processes", new algorithmic strategies such as deep learning, artificial intelligence and internet of things. In addition to the above areas, exceptional candidates in any field within the domain of mechanical and process/chemical engineering will also be considered. The Department of Mechanical and Process Engineering is committed to promoting interdisciplinary and cutting-edge research – covering the full range from fundamental to applied – and working to meet societal challenges. The new professors are expected to provide inspiration and leadership in research, contribute proactively to both undergraduate (in German or English) and graduate level (in English) teaching, establish an independent research profile while advising doctoral students and mentoring scientific staff and add to the diversity of the academic community. Successful candidates should hold a PhD or equivalent degree in mechanical engineering, process/chemical engineering or a related field at the beginning of employment.

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– Foundations of Cryptography
– Privacy
– Programming Languages/Software Engineering
– Security of IT Infrastructure
– Software Security
– Trustworthy Software

Please apply for only one of the above areas as all applications will be jointly reviewed.

Applicants should be strongly rooted in computer science, have internationally recognized expertise in their field and pursue research at the forefront of computer science. Successful candidates should establish and lead a strong research program. They will be expected to supervise doctoral students and teach both undergraduate and graduate level courses (in German or in English). Collaboration in research and teaching is expected both within the department and with other groups of ETH Zurich and related institutions.

Assistant professorships have been established to promote the careers of younger scientists. ETH Zurich implements a tenure track system equivalent to other top international universities.

Please apply online: *www.facultyaffairs.ethz.ch*

Applications include a curriculum vitae, a list of publications with the three most important ones marked, a statement of future research and teaching interests, the names of three references, and a description of the three most important achievements. The letter of application should be addressed **to the President of ETH Zurich, Prof. Dr. Lino Guzzella. The closing date for applications is 5 December 2018.** ETH Zurich is an equal opportunity and family friendly employer and is responsive to the needs of dual career couples. We specifically encourage women to apply.

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