Interdisciplinarity and Lifelong Learning in Doctoral Education for Sustainable Development: A Case Study on the Agenda 2030 Graduate School at Lund University

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Abstract

The 17 UN Sustainable Development Goals (SDGs) provide a framework for "peace and prosperity for people and the planet, now and into the future" (UN, 2015). Fast-moving societal questions as the ones related to the SDGs are often addressed from within traditional disciplinary research paradigms, which might not be best equipped for tackling the emerging challenges. At Lund University, an interdisciplinary Graduate School is working to address the growing societal challenges, utilizing the SDGs framework. We here investigate how the SDG framework influences the choice of research topics and supervisors in doctoral education, both at the beginning of doctoral studies and over time. We use semi-structured interviews with three doctoral students and with the Graduate School's coordinator. We conclude that while the SDGs provide a shared language

and framework for discussions, the research is mostly disciplinary. The Graduate School, however, provides opportunities for doctoral students and their supervisors to connect beyond their discipline and be exposed to new ideas and inspiration. Utilizing these opportunities would turn the Graduate School into a lifelong-learning hub, thus increasing awareness of changes in areas such as technology, finance and politics.

Introduction

Sustainability and the Agenda 2030 Graduate School

Increasing challenges – environmental, social and economic – have brought sustainable development to the center of attention, in practice, policy and research – mainly in the form of the 17 UN Sustainable Development Goals (in the following called "SDGs"; UN, 2015), which were adopted by the United Nations General Assembly in 2015. As politicians, cities and municipalities around the world are striving to go from words to action in response to the SDGs, the need for new knowledge on sustainability becomes evident. The pressing situation has placed high demands on universities to step up in relation to sustainability. "Sustainability" has moved from being a particular research interest to becoming a more mainstream concept that many fields of research connect to – a development that potentially increases the relevance and impact, but also the complexity, of researching sustainability.

Lund University has responded to the growing demand for knowledge and academic skills in sustainability in a number of ways, of which the establishment of a research school on sustainability is one of the more prominent. In 2018, Lund University established the *Agenda 2030 Graduate Schoo*l for doctoral students, the so-called "Graduate School". The initiative is unique in Sweden insofar as it is university-wide, including all nine faculties of Lund University. It is also the first research school in Sweden built around the 2030 Agenda for Sustainable Development. The intention of the Graduate School, and its relation to the SDGs, is described by its coordinators (Jönsson & van Meeningen, 2021): "The vision encapsulated

in the agenda and its 17 Sustainable Development Goals (SDGs) is ambitious: to end poverty, violence and inequality and provide healthcare and universal access to education as well as environmental protection, clean energy and safe water and sanitation, to provide a few examples. Reaching these encompassing goals by 2030 will be an immense challenge, and new ways of thinking and innovative solutions will be necessary. By encouraging novel interdisciplinary collaborations across faculties, and by developing interdisciplinary research courses and educational tools revolving around sustainable development, the aim is to provide a new generation of researchers with cutting-edge knowledge that can contribute to a sustainable future."

The authors continue by suggesting that the Graduate School should serve as a platform, "for Agenda 2030-related education and an inventive approach to learning through interdisciplinarity." In response to this initiative, 17 doctoral students were employed at the end of 2019 and the beginning of 2020. The Graduate School grew further, when another 13 doctoral students were admitted in spring 2022, to a total of 30 doctoral students.

Four years into the process of establishing the Graduate School as an arena for "cutting-edge knowledge" on sustainability, there ought to be lessons that can be learned from their experiences. How is the intention to promote "novel interdisciplinary collaborations across faculties" being implemented? Are research topics adapting to the moving goalposts of pressing sustainability issues? What can we learn from the research school in terms of doctoral supervision? So far, the Agenda 2030 Graduate School at Lund University has not in itself been an object of research. In this article, we build on previous research on interdisciplinary doctoral education, which we review in Section 1.2, as well as an empirical investigation of this particular research school, which we report on in Section 2.2. We discuss our findings and present conclusions in Section 3.

Literature review: Challenges connected to interdisciplinarity in doctoral education

In order to solve urgent challenges, there is often an instinctive call for *interdisciplinarity* (Boden et al., 2011). However, this term is often used very vaguely meaning everything "synonymous with all things progressive, innovative, and creative" (Holley, 2010). A more useful definition of interdisciplinary research might be "inquiries which critically draw upon two or more disciplines and which lead to an integration of disciplinary insights" (Holley, 2010).

Attempts at interdisciplinary research are often made through doctoral training, but this leads to challenges because universities are not designed for cooperation across disciplines (Boden et al., 2011). Current approaches to doctoral training might even be considered "inhospitable to interdisciplinarity" (Golde & Gallagher, 1999) because of the focus on producing specialists, not generalists, when doctoral students working across disciplines need to be both, and "scientifically multilingual" (Brodin et al., 2020). It is often challenging for doctoral students who want to work interdisciplinarily to develop, and show, both breadth and depth in their knowledge and their research outcomes. As a first step, meeting people working in other disciplines is necessary and "encounters with other disciplines may help to increase these students' self-insight into who they are as researchers" (Brodin et al., 2020). However, even when opportunities are designed for people to meet and talk across disciplines, it does not happen by itself, there is a need for a supportive frame engagement (Holley, 2010). Since doctoral studies are a time during which many decisions are made, networks are built and habits are formed, all of which will heavily influence the future professional careers, the way in which doctoral students are introduced to and trained in interdisciplinary work needs to stay attentive to "the processes of learning, research, and service inherent to the graduate model" (Holley, 2010).

There are four main challenges for interdisciplinarity in doctoral education (Golde & Gallagher, 1999): finding a supervisor, dealing with potentially conflicting methodologies, building an intellectual community and overcoming fear.

Finding a supervisor

Since interdisciplinary research is still in its infancy and universities are more likely to hire disciplinary researchers, finding a supervisor to act as role model in interdisciplinary research is challenging (Golde & Gallagher, 1999).

In general, doctoral students become more independent over time, and supervisors more hands-off (Borg et al., 2016), so there is potential for a doctoral student to develop into an interdisciplinary researcher over time, even with a disciplinary supervisor. Nevertheless, selecting a supervisor and a topic for a doctoral thesis are decisions with far-reaching consequences. "Choosing an advisor with whom the student can build a supportive professional relationship is perhaps the most critical decision a student makes" (Golde & Gallagher, 1999).

There are criteria for prospective doctoral students regarding how to choose their supervisor, and models for how to evaluate them against each other (Ray, 2007). Still, supervisors are often chosen in a chaotic way, "which can become one of the reasons for regret, lack of motivation, and poor quality of research output" (Ray, 2007).

Closely linked with the decision about a supervisor is the decision on a research topic, and as with the decision on a supervisor, there are criteria for choosing a topic (e.g. Xia, 2013, and references therein; Isaac et al., 1989). According to Isaac et al., 1989, across all fields, the student's "own preference" is the most important factor in the choice of a topic. After that, the most important factors are generally "trends in the field", "own life experiences" (except for engineers!), "adviser's preference" (which is the second most important in Engineering). Natural science supervisors are typically more involved in topic selection than supervisors in social sciences or humanities (Xia, 2013). In Engineering, the most important factor, together with one's own and the supervisor's preference, is that "equipment was available", and "financial limitations" are also relatively important. However, the criteria for choosing a topic are often not applied rationally (Xia, 2013).

Mastering knowledge and reconciling conflicting methodologies

Universities are very much disciplinary silos, which can present a "formidable obstacle for participating in interdisciplinary work" (Holley, 2010). This is because striving for breadth in addition to depth might not be seen as worthwhile as focusing solely on depth (Holley, 2010; Gardner et al., 2012), but also because "academic behaviour, knowledge production, and institutional logic" (Holley, 2010) are defined in each of the silos individually and might conflict with culture in others.

If interdisciplinary doctoral education is attempted, the focus should be on helping doctoral students develop a wide enough knowledge of techniques and methodologies, so they can (practice to) participate in discussions in disciplines other than their own (Holley, 2010 and 2015), which helps them gain confidence in situating their own research (Mobjörk et al., 2020). Doctoral students should also be given opportunities to gain experience of interdisciplinary research, for example through internships in interdisciplinary groups (Holley, 2010).

Finding an intellectual community

Doctoral students embarking on interdisciplinary research need to develop an interdisciplinary network to discuss ideas with and build collaborations. One important aspect is to actively involve supervisors and other senior researchers as role models and as members of an intellectual community in the design of interdisciplinary doctoral education (Holley, 2015; Mobjörk et al., 2020), both in terms of the formal curriculum (Holley, 2010 and 2015) and in informal social events (Holley, 2010). Developing a "safe arena" (Golde & Gallagher, 1999) in order to practice interdisciplinary research is key. In successful examples of interdisciplinary doctoral education, the intellectual community and support seems to most often develop among peers, not so much involving supervisors and other senior researchers (Gardner et al., 2012).

Overcoming fear

There are many valid fears associated with interdisciplinary research: That it is not valued as highly as disciplinary research because of the focus on depth vs breadth, that colleagues might not understand it, that journals

which will publish interdisciplinary research have a lower profile than disciplinary journals and that the combination of these factors will make it more difficult to get a job in the academic job market (Golde & Gallagher, 1999).

Other challenges and the way forward

In addition to these four challenges, there are also organizational barriers to interdisciplinarity (Boden et al., 2011). For example, offices and laboratory spaces are usually designed for, and under the control of, one specific discipline. Hiring of doctoral students usually happens based on disciplinary criteria, which promotion decisions are also based on. So, an "open discussion of the politics of interdisciplinarity" and the recognition that a successful interdisciplinary doctoral student might need to be qualified in non-traditional ways in the discipline, is needed (Boden et al., 2011). There are criteria for how to select the best candidate for a doctoral position (not just based on familiarity or gut feeling), and good criteria and their consistent application might go a long way (Lindelöw, 2010).

To overcome the challenges for interdisciplinary doctoral education described above, there is a need for "holistic solutions and systems thinking" (Golde & Gallagher, 1999), or even leveraging multiple theories of change (Kezar and Holcombe, 2019) to support the design of specific activities or programs and purposefully create and use synergies.

Interview study

Materials and methods

For this study, we conducted three semi-structured interviews with current doctoral students in the Graduate School:

- Doctoral Student A, 26 months into their PhD, face-to-face interview, on 2 March 2022, duration 65 minutes.
- Doctoral Student B, 29 months into their PhD, face-to-face interview, on 3 March 2022, duration 62 minutes.

- Doctoral Student C, 30 months into their PhD, Zoom interview, on 11 March 2022, duration 37 minutes.

Since two of the doctoral students preferred to remain anonymous, we are protecting their identity by referring to all doctoral students with the gender-neutral, third-person pronoun they/them/their.

One semi-structured interview was conducted with the Coordinator of the Graduate School, Kristina Jönsson:

- Face-to-face interview, on 8 March 2022, duration 73 minutes.

Empirical investigations

How are research questions chosen, developed and adjusted over time within the school?

Student A explains that they were very free in choosing their research questions. A first version of their questions was articulated already in their application. The questions then developed and changed in dialogue with their supervisors. "The questions changed organically in response to influences from different contexts. What I read and whom I meet. I am influenced by many different actors."

Student B received the research questions as settled, but they then developed the questions further with feedback from their supervisors. The research questions are decided on a study-by-study basis, and there are no overarching questions for their whole thesis.

Student C wrote a proposal with a research question in response to a call specifying a general research area. When they started working on it, they changed to an entirely different research question that, however, still lies within the general research area. This fundamental change was based on interest. Smaller changes in the methodology were later decided on based on getting a wider understanding of the field.

What is the framework in which research questions are chosen?

Two notions have been particularly important in terms of framework from student A. In their work, they draw primarily on the notion of sustainability

and the notion of architecture. They explain that they have also constructed "a smaller framework" within those broad notions, where architecture means planning, and sustainability is addressed through critical theory, including feminist theory.

"I work based on the background of the study", student B says. Therefore, after defining the research questions, they see how it fits in connection with the SDGs, rather than looking specifically at a certain SDG. Student B concludes that their research subject is inherently connected to the SDGs, thus it is not difficult for them to hit a few sustainability targets in every study.

For student C, both the initial and then the actual research questions were linked to the SDGs, but the SDGs were not a primary motivation to study the exact topic – that was driven by a more general idea of sustainability and innovation.

The Graduate School and the UN SDGs

What is the relation between the Graduate School and 17 SDGs agreed upon by the United Nations? Are students encouraged to work with particular SDGs and subgoals?

Student A explains: "Yes, we are encouraged to define what goals we work with in the research school. It has been a way to find others who work with the same goals. Keywords have been helpful to catch sight of each other and shared interests, to find overlaps."

Student A continues by explaining that they do not work with particular SDGs, but more with the framework Agenda 2030, and how it sits within the growth paradigm. They do not know at this point whether they will relate to any particular SDG subgoals, though they say they might connect to them later. "The focus will not be how to meet the goals, but rather a critical perspective on the goals as such – on the western, growth-oriented approach to sustainability."

Student A explains that this approach to Agenda 2030 is not typical of the group of students, but also not unique. There are other doctoral students with a critical perspective on Agenda 2030 in the Graduate

School. Whereas some students focus on the fulfilment of the SDGs, others take a more critical approach to the agenda.

Student B explains that the Graduate School does not change the fundamentals of their research, but rather adds a new perspective to it. They also acknowledged the role of the Graduate School in arranging common courses and seminars connected to the SDG topics, which could promote achieving SDGs.

Student C links to SDG subgoals, but these are not driving their work. Nevertheless, the subgoals are a good way to connect with other students and find a common language.

The coordinator of the Graduate School describes the approach to the SDGs as holistic rather than detailed. She highlights communication as key to working with Agenda 2030, describing the Graduate School as a place where one can problematize the agenda by looking at it from different angles. It is then crucial to find a language for interdisciplinarity, to find ways in which students can communicate across departments and affiliations. This challenging task is made easier since the motivation is high. "I think all doctoral candidates who applied to the program want to make a change, perhaps more than others and more outreach, we have high ambitions!"

Interdisciplinary work and supervision

Is interdisciplinary supervision needed, and to what extent is it happening? Has it changed over time? To what extent are students looking for expertise from other disciplines?

Student A has three supervisors from their own department. Student A has had no insight into the process of choosing the supervisors. "I was appointed three supervisors from the beginning, and I didn't know enough to ask the right questions at that time." They suggest that it would have been good for them to have a supervisor from another discipline or department. It would also have been good to have a "free seat" for a third supervisor to join when the project was developing. This, the possibility to add the expertise that is needed as the project develops, is interesting in terms of doctoral supervision.

Before joining the Graduate School, student A had an expectation of more interdisciplinary support. "I expected more of a system for interdisciplinary work, but there seems to be administrative hindrances to work like that. I also expected more formalized forms of collaboration in general, which is not really happening. The administration seems too difficult. It follows the university logic, where things happen inside each department. It is now up to oneself to do interdisciplinary work." Student A's experience is that the demands on the doctoral students, besides writing a thesis, are relatively few. In relation to what they understand as their main duty in the Graduate School – to write an interdisciplinary dissertation – student A would have liked to have more structure in terms of interdisciplinary work. "It is hard to prioritize collaborative work without clear incentives. We do meet once a month – but there are only possibilities, no obligations. The group might have been stronger if there were more formalized assignments on collaborative or interdisciplinary work. It is fully up to the individual student and their engagement, and sometimes people don't show up."

Student A suggests, however, that it might also be an advantage to belong to one department, as it might have caused more stress to be in between disciplines at the beginning of one's academic career.

"It is a tricky question", student B answers and adds "in order to make a clean transition, we need to be able to communicate". They think that sometimes you need to be specialized, as you will not reach the best journals to publish in, indicating that interdisciplinarity may not be academically relevant in that way. However, one can gain more attention with interdisciplinarity, i.e. more accessible research outcomes to read and understand, they argue.

Student B has two supervisors from the same department and another two from different disciplines. One of their supervisors is from a completely different background, which adds the interdisciplinarity aspect to their work. "It is a very good learning opportunity for me, it adds to the scope of my work", student B says. On the other hand, challenges exist when one tries to do such interdisciplinary work with their background, highlighting "I am not trained to carry out this piece of work" – yet this addition will resolve more societal challenges. Some groups in the Graduate

School hold mini-workshops together with a common theme, mostly people interested in theory, student B comments regarding looking for expertise from other disciplines.

Student C has two supervisors from the same department, because the supervisor with whom the project was developed was initially not allowed to supervise, so a second one in the department was assigned to fulfil the regulations on supervision. Student C does not want to add a third one because that feels like it would be too many.

At the same time, student C is currently abroad to run experiments with another group and learn from them, so there is a general interest in receiving new and different input.

Student C reports that the Graduate School, with its focus on both sustainability and interdisciplinarity, plays a strong role in helping them "keep sustainability in mind", "keeping me in check", and reports on interactions with other students that have changed student C's view on their own research in a bigger context. In particular, student C says that it is very easy, in the culture of their home department, to fall into the trap of just thinking "profit, profit, profit" and that this is balanced by the Graduate School.

The coordinator confirms that it has not always been so easy to meet the interdisciplinary intention of the Graduate School in practice. The first four years have shown that the ability or "readiness" to work interdisciplinarily differs greatly between faculties. Although many of the supervisors are already working with interdisciplinary topics, there is often a lack of time to reach out and do things differently. Although people are enthusiastic about the idea, the move towards more interdisciplinary work is, according to the coordinator, a slow process. Interdisciplinarity happens mainly where it is already happening at the department. Another challenge is the decentralized structure of Lund University – making monetary transactions, as well as translation of credits, rules and regulations, between departments and faculties difficult. She explains how the office of the Graduate School has adjusted its ambitions accordingly. They work with the idea of creating a space where people should at least "be aware of each other" and where broad and interdisciplinary discussions can take place. They are also encouraging supervisors to engage as teachers in creating

interdisciplinary graduate courses within the framework of the Graduate School. There have been seminars on the topic of interdisciplinarity for the doctoral students. For the supervisors, however, there is no budget for providing any training or particular support in relation to the challenges of interdisciplinary work.

Interdisciplinary work and the feeling of belonging

Student A has a stronger feeling of belonging to their home department than to the research school as such. "I have resources in the research school, but the framework has been built within the department primarily."

Student A feels supported in terms of supervision. Since they started, they have experienced a friendly and encouraging atmosphere, both at their home department and at the Graduate School. Student A suggests, however, that the supervisor's relation to the Graduate School could be strengthened. All supervisors are invited to the research school once a year with the student and once a year without the student, but those meetings could, according to student A, have been more useful if they were more structured. Student A describes how it is now up to them to keep their supervisors updated on the progress of the Graduate School. The supervisors from different departments do not know or meet each other. Students do not usually meet the other supervisors, except sometimes at courses.

"For me, I am attached more to my department than to the Graduate School when it comes to the basis of my research work", says student B. They believe that their supervisors are interested in the Graduate School and what they do there, but with minimal engagement. They mention that the supervisors of all students in the Graduate School often meet every semester, mostly via digital platforms. Similar to student A, student B concludes "We do not talk much about the Graduate School, I just update them about my engagement in seminars, courses, etc."

Student C also reports that there does not seem to be much of a connection between the supervisors and the Graduate School. The supervisor might be involved in some projects, but if so, student C does not know about it.

Sustainability and the need to adapt research to changing realities

One challenge of supervising doctoral students on sustainability is the nature of sustainable development. It is a disputed notion, but also a "moving target". Are doctoral students adapting their research questions to urgent sustainability topics? And if so, what do they actually mean by "adapting"? For example, change in the type of language used to describe it, change in "official" motivation for the research, or actual substantial change to the research question?

Student A explains how the object of their study, the built environment, is more stable than other parts of society. The making of a new area will not be immediately affected or changed by a new IPCC report; since everything is already planned, it will stay more or less the same. Student A refers to this as the slowness of planning. They continue to explain how their project relates less to climate change and more to social sustainability, a field that is not perceived as urgent. "It is more stable in that sense, inequalities do not usually demand such fast action, although I think of it as equally urgent."

Student B believes that their field of research is fitting decently with (urgent) sustainability topics, thus they do not find it difficult to adapt their research questions in this context. However, they think that this might vary significantly between students in the Graduate School, especially with those who are focused on theories based on sustainability.

Student C does not see their research questions adapting to changing realities, even though they are working on a fairly new technology.

Other points from the interviews

In addition to all the functions mentioned above, the Graduate School plays another important role, and that is providing students with an external perspective, a place to talk with people outside of the context of students' home departments, and moral support. Student C says "I do not think I would survive my PhD without the graduate school".

Lastly, the Graduate School is not just funding doctoral positions, but also research stays abroad (currently student C).

Discussion and conclusions

We structure our discussion according to the challenges identified in the literature review above.

Finding a supervisor

Earlier research has highlighted the importance of the selection of a supervision team for a doctoral thesis. The choice of a supervisor has been described as potentially "the most critical decision a student makes" (Golde & Gallagher, 1999). Drawing on this suggestion, it is interesting, and perhaps a bit troubling, to note that the doctoral students interviewed for this study were hardly part of the process of choosing their supervisors. They were all assigned supervisors from the very beginning, or even, as in the case of one student, in the description of the PhD position they applied for.

The doctoral students expressed that they were hoping for more flexibility in terms of supervisors. One student was highlighting the need to adjust the supervision team as the project proceeded into new fields of knowledge. The same student expressed that it had been difficult for them to take an active part in the choice of supervisors at the beginning, because they had too little insight into the actual process of doctoral studies at that time. In response to the need for interdisciplinary supervision, one of the doctoral students added a fourth person to the supervision team. One of the other students said they have been thinking of that possibility, but decided that it was not worth it, since having four supervisors would potentially be too many to handle. Another student thinks that even three supervisors would be too many.

Drawing on the students' experiences, and on earlier research (Golde & Gallagher, 1999), we suggest that doctoral students working in the interdisciplinary field of sustainable development would often benefit from having supervisors from different disciplines. The challenge to find the right combination of competencies in the supervision team from the beginning has been highlighted in the interviews. Agreeing with Golde & Gallagher (1999) that the choice of supervisor is a critical decision for any doctoral student, we advocate a model where the doctoral student has the

possibility to add co-supervisors (second or third) a bit into the process of developing their project.

Dealing with potentially conflicting methodologies

In interdisciplinary research, one big challenge is that different disciplines use different methodologies or interpret the same ones in different ways. Interestingly, while all the doctoral students we interviewed were very much aware of the danger of this happening (as becomes clear for example by them not wanting to add more supervisors, or expressing that they think it is easiest to work out of one main research institute, as they do), only one has actually experienced this difficulty with a supervisor whom they connected with through the Graduate School, and who brings in a very different experience, point of view and methodology. This strengthens our argument that, while all doctoral students have interdisciplinary conversations within the Graduate School (and enjoy those!), for only a few this extends to their actual research, which is mainly disciplinary.

Building an intellectual community

The importance of role models when creating an interdisciplinary intellectual community has been highlighted in the literature (Holley, 2015; Mobjörk et al., 2020). Although the building of an intellectual community is very much the focus of the Graduate School, this seems to be lacking. Drawing on the interviews with doctoral students, as well as on the interview with the coordinator, community building within the Agenda 2030 Graduate School is mainly happening on a peer-to-peer level. A development that is typical for the development of an intellectual community in interdisciplinary doctoral education, according to earlier studies (Gardner et al., 2012). Building on that, the Graduate School seems to be really good at promoting a sense of community among its students. The interviews show that the Graduate School functions as a supportive structure within which the doctoral students can get acquainted with new perspectives and find shared interests across disciplines. This could be compared to the "safe arena" as described by Golde & Gallagher (1999) – a space in which one may practice interdisciplinary research. Kristina

Jönsson, the coordinator of the Graduate School, did however express a wish for the Graduate School to grow into an intellectual community that also includes supervisors and other senior researchers.

Overcoming fear

Fear – especially focused on a future as an interdisciplinary researcher – has not come out as a big topic in our interviews. However, it has become very clear that there is a strong support network within the Graduate School (see also Section 3.3), which is explicitly centered on an office, without which at least one doctoral student states they would not be able to finish their doctoral thesis. One student expressed having had an initial fear of being "different" to the rest of the group in their critical approach to the UN SDGs. This fear disappeared when they met the group, and what they experienced as an enabling and open atmosphere. The same student expressed a fear that working fully interdisciplinarily would have been too difficult as a young, inexperienced researcher. The fear of not getting a job after interdisciplinary doctoral studies (Golde & Gallagher, 1999) did not surface in any of the interviews.

Other challenges

In our interviews, we have found that the other challenges described in the literature are also experienced within the Graduate School: there are no common spaces that are easily accessible to all doctoral students, especially no shared laboratory spaces. In addition, organizing the Graduate School across all the different faculties seems to be a challenge since all structures are decentralized: how finances or reporting works, whom to include in decision-making.

In summary, we have found that all these challenges are real, but solvable. Golde & Gallagher (1999) suggest that "tackling them requires holistic solutions and systems thinking". We would even suggest going beyond systems thinking towards leveraging multiple theories of change (Kezar and Holcombe, 2019): using several theories of change simultaneously can support the design of specific activities or doctoral education as a whole, and more generally, there are synergies that can

purposefully be leveraged. Inviting everybody into stimulating and significant venues and bringing in highly esteemed guest speakers supports the influence of prestigious personalities and institutions on participants. From an organizational learning perspective, annual meetings lead to sharing of information and experiences, which can result in adaptation of those new practices. Using a systems theory perspective, the meetings can reinforce an interdisciplinary framework, by using it as a guiding structure and always referring back to relevant documents. Moreover, from a network theory perspective, annual meetings can provide opportunities for informal and formal meetings and bonding situations in both random and planned groups. Thinking about the whole Graduate School in this way might lead to strategies that help anchor interdisciplinary thinking across all of Lund University, and manifest in interdisciplinary doctoral research in steps towards sustainable development.

Sustainability as a subject or a perspective

The study has pointed to the challenges of working interdisciplinarily on the topic of sustainability. The interviews, when read together, show that doctorates are primarily awarded within traditional disciplines. They also show that being rooted in a discipline is perceived as a comforting experience. The inclination to work within defined disciplines leads to the question of how research on sustainability is best conducted. Is it beneficial to work with sustainability as a perspective present in multiple disciplines, as seen in the Graduate School, or should it rather be addressed as a discipline in itself?

As the demand for expertise in sustainability grows, we see more initiatives to establish sustainability as an academic discipline of its own. It is, however, more often addressed as an interdiscipinary or transdisciplinary research field. (A nearby example of a transdisciplinary approach is the establishment of the research field "Sustainability science" at Malmö University). All three approaches have their pros and cons.

Knowledge on sustainability is, however, not a strictly academic affair, it is on the contrary something that engages practitioners in many different fields and professions, including both the private and public sector. It is,

however, not always easy to keep up with the fast development of sustainable development related to various fields. We see that the university can play a role in terms of lifelong learning, by providing teaching units on sustainability for practitioners wanting to update their skills and knowledge. When offering this kind of education for practitioners, it is important for academia to stay close to the subject and the "reality" of the practitioners. The disciplinary approach to sustainability might thus stand a better chance of being more relevant to practice.

However, there are also potential drawbacks to a strictly disciplinary approach as it may not always be sufficient when facing multifaceted and complex issues. (Here we must remember that sustainability issues are often characterized by a high degree of complexity due to their interconnectedness with social, economic and environmental systems.) It is therefore possible to assume that in some situations an interdisciplinary approach is more valuable (also for practice) as it allows a diverse range of perspectives to be brought to bear on a problem. Interdisciplinary work may require more coordination and can potentially be more time-consuming, as the interviews have shown. Interdisciplinary work on sustainability may on the other hand provide more holistic, insightful and potentially more innovative solutions. Overall, it is important to understand that the pros and cons of interdisciplinary work depend to a great extent on the specific situation and the objective of each project. Further research is needed to better understand the strengths and the limitations of both disciplinary and interdisciplinary approaches in relation to sustainability work and research.

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References

Boden, D., Borrego, M., & Newswander, L. K. (2011). Student socialization in interdisciplinary doctoral education. *Higher Education*, *62*(6), 741-755.

Borg et al. (2016). *Autonomy in PhD-education – Supervising for independence* https://journals.lub.lu.se/pige/article/view/21197/19104

Brodin, E., Lindén, J., Sonesson, A., & Lindberg-Sand, Å. (2020). *Doctoral supervision in theory and practice*. Studentlitteratur AB.

Gardner, S. K., Jansujwicz, J. S., Hutchins, K., Cline, B., & Levesque, V. R. (2012). Interdisciplinary doctoral student socialization. *International Journal of Doctoral Studies (7):* 377-394. https://scholars.unh.edu/cgi/viewcontent.cgi?article=1643&context=faculty_pubs

Golde, C. M., & Gallagher, H. A. (1999). The challenges of conducting interdisciplinary research in traditional doctoral programs. *Ecosystems, Vol 2*, No. 4, 281-285. https://www.jstor.org/stable/pdf/3659018.pdf

Holley, K. (2010). Doctoral student socialization in interdisciplinary fields. *On becoming a scholar: Socialization and development in doctoral education*, 97-112. https://smaratungga.web.id/library/repository/%5BSusan_K._Gardner,_Pilar_Mendoza,_Ann_E._Austin%5D_O(BookFi.org).pdf#page=116

Holley, K. S. (2015) Doctoral education and the development of an interdisciplinary identity, Innovations in Education and Teaching International, 52:6, 642-652, DOI: 10.1080/14703297.2013.847796 https://www.tandfonline.com/doi/pdf/10.1080/14703297.2013.847796

Isaac, P. D., Koenigsknecht, R. A., Malaney, G. D., & Karras, J. E. (1989). Factors related to doctoral dissertation topic selection. *Research in Higher Education*, *30*(4), 357-373. https://link.springer.com/content/pdf/10.1007/BF00992560.pdf

Jönsson, K., & van Meeningen, Y. (2021). Promoting Change in Higher Education: Lund University Agenda 2030 Graduate School. *Academic leadership in times of transformation*, 287-297.

Kezar, A., & Holcombe, E. (2019). Leveraging Multiple Theories of Change to Promote Reform: An Examination of the AAU STEM Initiative. *Educational Policy 35* (6), 985–1013. DOI: https://doi.org/10.1177/0895904819843594

Lindelöw, M. (2010). *Kompetensbaserad personalstrategi*. Natur & Kultur.

Mobjörk, M., Berglund, C., Granberg, M., & Johansson, M. (2020). Sustainable development and cross-disciplinary research education: Challenges and opportunities for learning. *Högre utbildning*, *10*(1), 76-89. https://hogreutbildning.se/index.php/hu/article/view/1942/4301

Ray, S. (2007). Selecting a doctoral dissertation supervisor: Analytical hierarchy approach to the multiple criteria problem. *International journal of doctoral studies*, *2*, 23. http://www.ijds.org/Volume2/IJDSv2p023-032Ray18.pdf

UN (2015). https://sdgs.un.org/goals (accessed on March 21st, 2022)

Xia, J. (2013). *A mixed method study on students' experiences in the selection of a dissertation topic*. Arizona State University. https://keep.lib.asu.edu/_flysystem/fedora/c7/88339/Xia_asu_0010E_13176.pdf