Perspectives on supervising and conducting interdisciplinary research projects

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Abstract—**This study has been carried out as an assignment in the 2021 Readership Course (GB_S91) at LTH. The motivation for this study was to obtain a further understanding of the situation of PhD students and supervisors who operate in an interdisciplinary research context. The focus is on finding the positive aspects, as well as existing challenges, to comprehend how to provide future PhD students with adequate support and inclusive environments. To unravel what constitutes a winning strategy when supervising PhD students in an interdisciplinary environment, we have conducted interviews with PhD students and supervisors active in interdisciplinary research projects at LTH. A general conclusion is that both PhD students and supervisors have a positive perspective towards interdisciplinary research with an emphasis on the interesting and inspirational challenging aspects. The main negative issue raised by PhD students is confusion about which supervisors he/she should turn to for help in different situations. The supervisors on the other hand address challenges related to communication, financing, publication, and recruitment.**

Index Terms—**Interdisciplinary research, PhD education, supervision**

I. INTRODUCTION

INTERDISCIPLINARY research (IR) is not easily defined. Terms like multi-disciplinary and transdisciplinary also appear [1]–[4], and definitions are ambiguous [5], [6]. Often, definitions relate to the integration of concepts, theories, or data from two or more disciplines [7], [8], or working on complex challenges [9]. Existing literature typically covers the challenges or opportunities for researchers and the benefits of IR projects.

Interdisciplinary researchers can facilitate a greater understanding of the 'whole picture' [10]. This implies that there are challenges and opportunities involved for both PhD students and supervisors in such projects. PhD students engaged in IR typically learn to work in an approach and 'language' that is accepted in all involved disciplines [1],

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[11], [12]. Therefore, they often become sought-after translators [13]. An interdisciplinary collaboration tends to be inclusive, open-minded and with few rules [9]. IR also provides the opportunity and possibility to fill gaps of knowledge that exist between bodies of established knowledge [7]. There are also arguments that IR has the potential to support the understanding of and solve complex challenges, whereas traditional disciplinary methods only provide a one-dimensional understanding [10]. IR has a good chance of resulting in new *types* of results. This is of course very motivational for an individual researcher [6]. Another motivation is the opportunity to conduct research with the potential of 'real-world' impact [14].

A. Challenges and traits of interdisciplinary researchers

Interdisciplinary projects can originate to investigate and fill gaps of knowledge between existing research areas, but the origin can also be from a lack of trust and collaboration within the student's faculty, thus forcing the student to look for alternative collaborators outside their field [6].

The time and effort required to carry out a PhD education in interdisciplinary research, where they have to develop expertise in more than one area, leave some students overwhelmed [1], [15], [16]. Additionally, there is less money made available to IR projects, since methods, concepts and competencies described in proposals are harder to oversee by the review committee [6], [17], [18]. The lack of insights and knowledge when designing an IR project can lead to unrealistic expectations from the involved partners [15]. PhD students find it difficult to locate supervisors interested and capable of joining an IR project [1], [11]. It can also be hard to find examiners who understand the interdisciplinary field [15].

Relationship-building skills, patience and long-term planning are the clearest prediction factors for successful engagement in IR [5], [9], [10]. Research shows that risk-taking [6], open-mindedness [13], active listening [10], [19], jargon avoiding [10], [20] and researchers with strong self-esteem [10], [21] excel in IR.

II. METHODOLOGY

A qualitative methodological approach was used in this study. Six interviews were carried out with PhD students and five with supervisors. The qualitative inquiry enabled the examination of attitudes and experiences [22]–[24]. However, as only interdisciplinary researchers were interviewed, the study lacks generalizability.

III. RESULTS AND DISCUSSION

The PhD students' and supervisors' perspective on IR is mainly positive. Being forced to include multiple fields in

their research is described as both interesting and challenging. Table 1 summarises interview responses related to important personal traits, challenges and opportunities related to interdisciplinary studies from both PhD students and supervisors at LTH.

TABLE I
INTERVIEW FINDINGS

Aspects	PhD Student	Supervisors
Important traits	- Independent, but not limited to asking for help when needed. - Curious. - Easily communicate and explain their respective research field. - Understand both the details and have a good overview. - Being open. - Self-motivated. - Listen and ask questions.	- See the needs and struggles that the PhD student faces. - Empathic. - Academic skills.
Communication	- Increased potential.	- Can be hard to understand each other. - Can take a long time to establish good communication.
Funding	-	- Easier to obtain. - Hard to obtain due to disciplinary funding schemes.
Publication	- Need for a more generalized way of writing. - Easy to find journals. - Hard to find journals - The feeling of having a weak manuscript.	- Harder to publish. - Need to combine different writing styles. - Hard to find relevant review articles. - Challenging to select journals for publication.
Supervision situation	- Hard to find full support. - Need to prioritize what to learn and what to do. - Not meeting the co-supervisors often enough.	- Lively discussions. - Focus on learning new things. - Sometimes need more extensive supervision. - Need to find consensus in prioritizing research goals and tasks. - Handle differences in preferred focuses.
Research opportunities	- More tools. - Positive challenges. Problem with 'who does what?' - Not a 'master' of all the techniques. - Obtain broader perspectives.	- Fun. - Positive challenges. - Curiosity-driven. - More interesting results. - Obtain broader perspectives and knowledge. - Broader research network. - Give birth to new ideas.
Career	- More job opportunities	- More job opportunities. - Stronger future researcher. - Strong competence.

Effective communication between supervisors from different disciplines and their PhD students is crucial for success. Clear communication is key to avoiding problems, as highlighted by one supervisor, while another one points to funding disagreements, where it is challenging to secure research funds due to disciplinary financial models. Yet, others active in the IR field find funding more accessible. This variance could be due to the closeness of the disciplines within the IR fields, as inferred from the differing views of two supervisors with 15-17 years of experience in IR.

When supervising PhD students, expertise dictates co-supervisor selection, ensuring comprehensive coverage of the various IR fields. The interpersonal dynamics between supervisors and the PhD student also shape the supervision strategies. Some supervisors reflect on the need for better initial coordination and aligned expectations for the student.

While main supervisors often conduct meetings with PhD students, co-supervisors might be busy with other research, and may only meet the student individually to leverage their specialized knowledge. However, occasionally, all supervisors come together for joint meetings. The frequency of these meetings is crucial; they should be neither too frequent nor too infrequent, with the PhD student having a say in their timing.

Opinions on supervision consensus vary. Some supervisors note a lack of consensus on research topics, with each focusing on their niche, which can lead to productive discussions. The open-mindedness and non-pretentious approach of supervisors can turn differing viewpoints into an advantage, leading to more robust research outcomes. This diversity is also seen as beneficial for the PhD student's development, with supervisors generally agreeing on prioritizing the student's best interests and balancing their capabilities and interests. Publishing IR results presents mixed views. While some students find journals that perfectly match their research, others struggle with publishing. Supervisors note the importance of pin-pointing the focus of the article to find suitable journals, favouring more specific articles over broad ones. The emergence of interdisciplinary journals and the establishment of IR as a distinct field with its publications have eased the publishing process, which reflects the varying perspectives, similar to those regarding funding for IR.

IV. CONCLUSION

Interdisciplinary research (IR) inspires PhD students and supervisors with its potential for broader impact and connection. It spurs dynamic discussions focused on wide-ranging interpretations across experiments, contrasting the minute debates in disciplinary research with little overall impact. Curiosity and self-confidence are vital traits for navigating IR's expansive terrain and engaging with experts from strict disciplines. Experiences with publishing IR vary, likely being influenced by the maturity of the discipline collaboration, where long-term supervisors have seen an evolution from scarce publishing opportunities to specialized journals. Yet, a robust interdisciplinary study may seem lacking when scrutinized from a single discipline's perspective, emphasizing the challenge of bridging diverse academic fields within research narratives.

REFERENCES

[1] M. Vanstone, K. Hibbert, E. A. Kinsella, P. McKenzie, A. Pitman, and L. Lingard, 'Interdisciplinary doctoral research supervision: A scoping review', *Can. J. High. Educ.*, vol. 43, no. 2, pp. 42–67, 2013.

[2] J. T. Klein, *Interdisciplinarity: History, theory, and practice.* Wayne State University Press, 1990.

[3] J. T. Klein, 'A conceptual vocabulary of interdisciplinary science', *Pract. Interdiscip.*, vol. 3, p. 24, 2000.

[4] J. T. Klein, 'Integrative learning and interdisciplinary studies', *Peer Rev.*, vol. 7, no. 4, pp. 8–10, 2005.

[5] A. R. Rissman and L. Barrow, 'Characteristics of collaborative, interdisciplinary, and engaged research among graduate students in environmental conservation', *J. Environ. Stud. Sci.*, vol. 9, no. 3, pp. 297–310, 2019.

[6] M. I. Kaiser, M. Kronfeldner, and R. Meunier, 'Problems and prospects of interdisciplinarity: the case of philosophy of science', *Interdiscip. Sci. Rev.*, vol. 41, no. 1, pp. 61–70, 2016.

[7] K. A. Holley, 'Doctoral education and the development of an interdisciplinary identity', *Innov. Educ. Teach. Int.*, vol. 52, no. 6, pp. 642–652, 2015.

[8] A. L. Porter, J. D. Roessner, A. S. Cohen, and M. Perreault, 'Interdisciplinary research: meaning, metrics and nurture', *Res. Eval.*, vol. 15, no. 3, pp. 187–195, 2006.

[9] J. Blythe and C. Cvitanovic, 'Five organizational features that enable successful interdisciplinary marine research', *Front. Mar. Sci.*, vol. 7, p. 981, 2020.

[10] M. N. Wilson, A. E. Laufer, E. M. Howard, and J. A. Wong-Ala, 'Lessons from the trenches: students' perspectives of their own marine transdisciplinary education', *Front. Mar. Sci.*, 2021.

[11] C. M. Golde and H. A. Gallagher, 'The challenges of conducting interdisciplinary research in traditional doctoral programs', *Ecosystems*, pp. 281–285, 1999.

[12] A. E. Nisselle and R. E. Duncan, 'Multiple supervisors from multiple disciplines: Lessons from the past as multidisciplinary supervision becomes the way of the future', *Traffic Parkville*, no. 10, pp. 143–166, 2008.

[13] M. Kiley and D. P. Halliday, 'Candidate and supervisor experiences of doctoral study in a structured, interdisciplinary training environment', *Innov. Educ. Teach. Int.*, vol. 56, no. 5, pp. 663–674, 2019.

[14] B. Tress, G. Tress, and G. Fry, 'Integrative research on environmental and landscape change: PhD students' motivations and challenges', *J. Environ. Manage.*, vol. 90, no. 9, pp. 2921–2929, 2009.

[15] K. L. Blackmore and K. V. Nesbitt, 'Identifying risks for cross-disciplinary higher degree research students', presented at the Proceedings of the tenth conference on Australasian computing education-Volume 78, 2008, pp. 43–52.

[16] M. Mitrany and D. Stokols, 'Gauging the transdisciplinary qualities and outcomes of doctoral training programs', *J. Plan. Educ. Res.*, vol. 24, no. 4, pp. 437–449, 2005.

[17] S. Hornbostel and M. Olbrecht, 'Peer Review in der DFG: die Fachkollegiaten', 2007.

[18] K. Huutoniemi, 'Evaluating interdisciplinary research. Teoksessa R. Frodeman, JT Klein, C. Mitcham (toim.) The Oxford Handbook of Interdisciplinarity', 2010.

[19] P. S. Nurius and S. P. Kemp, 'Individual-Level Competencies for Team Collaboration with Cross-Disciplinary Researchers and Stakeholders', in *Strategies for Team Science Success*, Springer, 2019, pp. 171–187.

[20] M. O'Rourke, S. Crowley, B. Laursen, B. Robinson, and S. E. Vasko, 'Disciplinary diversity in teams: integrative approaches from unidisciplinarity to transdisciplinarity', in *Strategies for Team Science Success*, Springer, 2019, pp. 21–46.

[21] L. M. Bennett and H. Gadlin, 'Conflict prevention and management in science teams', in *Strategies for Team Science Success*, Springer, 2019, pp. 295–302.

[22] P. Bansal, W. K. Smith, and E. Vaara, 'New ways of seeing through qualitative research', 2018.

[23] E. G. Mishler, *Research interviewing: Context and narrative.* Harvard University Press, 1991.

[24] M. Patton, *Qualitative research and evaluation methods.* Thousand Oaks, CA: Sage Publications, 2002.