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The Need For Interdisciplinarity: A Case On Employees' Perspectives

Dennis FRIEDRICHSEN
Aalborg University, Denmark, friedrichsen@plan.aau.dk

Maiken WINTHER
Aalborg University, Denmark, maikenw@plan.aau.dk

Anette KOLMOS
Aalborg University, Denmark, ak@plan.aau.dk

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D. Friedrichsen[1]
Aalborg University
Aalborg, Denmark
0009-0004-3495-9153

M. Winther
Aalborg University
Aalborg, Denmark
0009-0001-3226-7151

A. Kolmos
Aalborg University
Aalborg, Denmark
0000-0002-0186-2839

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ABSTRACT

The issue of interdisciplinarity contains disparate nodes of knowledge and practices, including a wealth of information concerning the potential and value of interdisciplinary work. In the context of companies that handle large-scale and complex tasks, interdisciplinarity takes on a real-life role since its presence and importance is readily observable and, as this paper shows, a conscious, deliberate, and highly valued aspect of innovation in companies. Academic literature on the issue of interdisciplinarity asserts that engineers in the future need a wealth of competences, including ability to collaborate in interdisciplinary teams. Aalborg University in Denmark has experimented with interdisciplinarity in various PBL contexts; the guiding research problem of this paper concerns how work practices call for interdisciplinary competence development. Through this perspective, we gain

Corresponding author. D. Friedrichsen, friedrichsen@plan.aau.dk

insight into how interdisciplinary competences are relevant for students at AAU as a competence that must be proactively developed.

The data set consists of nine interviews collected from a large Danish company. The interviews have been transcribed using Nvivo and coded according to the research problem. As the results of the qualitative data indicates, interdisciplinarity is not just an important competence for employees, but also a prerequisite for problem solving. Results indicate that interdisciplinarity is a competence that students must develop because interdisciplinarity is actively used for problem-solving in the types of jobs that engineering graduates will get in the future.

1 INTRODUCTION

The value of interdisciplinarity is well-documented. In the context of interdisciplinarity, there exists disparate nodes of knowledge and practices and these make the issue more far-reaching and complex. Interdisciplinary collaboration may manifest in several ways and will depend on a number of factors, including company culture, individuals' proclivities, and existing practices. When companies handle large-scale tasks, the ability (and willingness) to work in interdisciplinary teams becomes not just valuable – it becomes a requirement for success [1] [2].

It is valuable for researchers to focus on issues such as interdisciplinarity because it directly affects students – both during their time in various degree programmes, but also post-graduation in their first jobs. While contemporary teaching models, including problem-based learning, highlight interdisciplinarity as a key area, there remain important questions concerning the issue, not least regarding how interdisciplinarity is taught and understood [3] [4]. Furthermore, there exists a strong connection between disciplinarity (which remains crucial) and interdisciplinarity, but the ways in which these areas interact is complex and often opaque – for both educators and employees [5].

At Aalborg University in Denmark, several projects and initiatives have strived to introduce students to problem-based learning and interdisciplinary collaboration. These include projects such as AAU Megaprojects, LeadEng, and Hackathon [6] [7] [8] [9]. While this has yielded interesting results, certain limitations have also been revealed. Students found their participation interesting and highly relevant, but experienced interdisciplinary teamwork as challenging and to some extent inhibiting for problem solving. It became clear that transforming disciplinary competences to an interdisciplinary context is challenging for students and that more support and guidance is needed. With the aim of letting the different initiatives reflect reality, the projects have been multi-, inter- and transdisciplinary. The question remains, then, whether experiences gained from initiatives like LeadEng are reflected in interdisciplinary work practices in the industry. Once a person changes from being a student to being an employee, how do they use and think of interdisciplinarity? In this context, the specific *experiences* employees have at a given place of employment will significantly impact and alter their perception of interdisciplinarity (and collaboration generally). While day-to-day operations may rarely require substantial levels of interdisciplinary collaboration (e.g. operating a crane), departments that

focus on innovation and other long-term perspectives rely on, and benefit from, interdisciplinarity to a high degree [1] [2]. Although employed at the same company, different departments may differ considerably with regards to culture, structure, understanding of key practices, and so on. With this in mind, this article is concerned with identifying the precise *understanding* of interdisciplinarity that employees articulate. Furthermore, we see most degree programmes as incorporating interdisciplinarity in various ways, but whether this corresponds positively to how interdisciplinarity is practiced in industry remains an open question. The guiding research question of this article is: What are employees' experiences with interdisciplinarity in practice and which competences are highlighted as important in this context?

2 METHODOLOGY

2.1 Research context

To gain insight into how employees understand interdisciplinarity in practice, this study is based on findings from a medium sized company in Denmark. Data has been collected through interviews with the company's innovation department, which specializes in innovation and (future) business models. The department is interdisciplinary in nature, housing both employees with engineering degrees and degrees from the humanities, working on internal and external projects.

2.2 Data collection

As this study is part of a larger project, this article acts as a pilot case providing an opportunity to explore understandings and experiences from the participants. The study is inductive in its approach, which provides an opportunity to follow interesting viewpoints among the participants that are not guided by predetermined topics of interest. The aim is to obtain insight into how interdisciplinarity is understood in practice.

The qualitative data was collected in January 2023 and consists of 9 interviews with employees with different educational backgrounds (see table 1). Each interview was collected individually and lasted approximately one hour. The interviews were semi-structured and provided the study with insight into how each employee experiences interdisciplinary collaboration – both in the context of internal and external projects. To minimize language barriers, the interviews were conducted in Danish. Any quotes have been translated by the authors.

Table 1. Educational backgrounds of the interviewed participants. All interviewees have been anonymized.

Background
Geography and Enviromental Management and Sustainability Science
Innovation Economy
Bachelor of Engineering

Master of Business Administration
History and Applied Philosophy
MSc in Organisation and Strategy
Economy and Political Science
Civil Engineering (Enviromental Management and Sustainability Science)
International Finance and Development Economics

The data has been transcribed using Nvivo and afterwards coded using thematic coding. This enables the study to become more focused, letting theory, or predetermined areas of interest, guide data collection. This study has been guided by the following themes: understandings of interdisciplinarity, competences relevant for interdisciplinarity, and the importance of interdisciplinarity in practice.

3 RESULTS

The data provides fascinating insight into the realities of working with innovation in a challenging and interdisciplinary context. The company itself, which manages both large logistical tasks while also attempting to innovate within research & development and be frontrunners, deliberately strives to have interdisciplinary teams solve complicated tasks. When asked specific questions about the realities of working in interdisciplinary teams and its effect on teamwork, it became clear that interdisciplinarity was not just a taken-for-granted aspect of working with large projects, but also a valued competence which simultaneously is a prerequisite for effective problem-solving. It also became clear that individual employees were able to drive projects forward as the onus is on them to make projects work. Furthermore, the employees are highly motivated and see their place of work as a boundary object which provides a common goal and common sense of purpose.

3.1 Work practice: what does interdisciplinarity mean to employees?

Concerning the importance of interdisciplinarity, it is relevant to unfold the interviewed employees' understandings of the term. The group of employees is generally synchronized as to how they understand interdisciplinarity.

Table 2. Different understandings of what interdisciplinarity means to employees

Themes	**Explanation**
Interdisciplinarity as different educational backgrounds.	Interdisciplinarity occurs when people with different educational backgrounds collaborate.
Interdisciplinarity as differences in both educational backgrounds and areas of responsibility.	Interdisciplinarity occurs not only when people with different educational backgrounds collaborate, but also

	concerns differences in functions and areas of responsibility.

Most interviewees define interdisciplinarity as being a group of people with different educational backgrounds working together to solve a common problem. One participant describes interdisciplinarity as a backpack of biases originating from both one's educational background but also one's upbringing. Everyone in the team brings in their expertise, and has different views of the project, collaboratively creating a common language. Two other interviewees expanded their understanding of the term: one sees interdisciplinary structures as collaboration among disciplinary backgrounds but also as collaboration across departments in a company. Here, interdisciplinarity is not only grounded in a disciplinary understanding of differences but also as differences between functions and areas of responsibility. Another agrees with this understanding and states that interdisciplinarity occurs when different fields of expertise or competence areas collaborate.

There exists an interesting (minor) disconnect between the employee's perspective on interdisciplinary collaboration and their view on management. For example, a participant observes that employees themselves facilitate and promote interdisciplinary collaboration, while management work in fixed and inflexible silos. Seemingly, autonomy is a prerequisite for productive interdisciplinary work and a common goal, or boundary object, is a central component in this regard as well. One participant noted that this is one reason why highly educated candidates are hired; they are self-motivated and able to progress towards their goals with little interference or (micro) management needed.

Possessing a goal-oriented mindset is a recurring theme that interviewees highlight. One participant defines interdisciplinarity as collaboration across multiple educational backgrounds, but also notes that they must, "solve a project together," and, "each have their own perspective concerning what must be delivered." Furthermore, it is mentioned that being aware of one's own and others' educational backgrounds is important, but it is equally important to be aware of one's own competence-related limitations. Typically, working in interdisciplinary teams provides insight into people's strengths and weaknesses, which turns into an advantage as employees are able to support each other and fill knowledge gaps. One participant stated that, "If I hadn't been aware of [my own limitations], then I could have spent a lot of time on something I don't really know anything about and then made poor decisions which might set back my time schedule." This is interesting because it highlights that depth of disciplinary knowledge is central, but a group's potential develops positively if a multitude of educational backgrounds all contribute – even backgrounds whose potential contributions may not at first be readily apparent.

Several interviewees also indicated that there is an unspoken (or tacit) component to interdisciplinary work. To a large extent this is related to generic competences. A participant notes that many important aspects of successful interdisciplinary

collaboration cannot be put into a formula. “Things happen around [an interdisciplinary] table that you cannot reduce to a formula, especially concerning mutual respect and other people’s cultural or work-related backgrounds.” Learning to have confidence in other’s contributions, and trusting that these are worthwhile, is a valued skill that develops as employees gain experience with interdisciplinary collaboration.

3.2 The importance of (inter)disciplinary competences

When asking the interviewees about their experiences with interdisciplinarity in regard to the importance of disciplinary competences, a tendency appears in the answers. Several of the employees articulate the importance of disciplinary competences in contrast to the more personal traits such as openness, curiosity, and engagement.

Table 3. Different understandings of the balance between disciplinary competences and personal traits

Themes	**Explanation**
Personal traits as a gateway for getting disciplinary competences into play.	Personal traits become necessary for establishing interdisciplinary teamwork and to get disciplinary competences into play.
Disciplinary competences and personal traits – you cannot say one without the other.	Personal traits and disciplinary competences as equally important.
Personal traits as more important than disciplinary competences.	Personal traits as more important than disciplinary competences.

One participant mentioned the importance of disciplinary competences in the team, but also stated that in the beginning your personal traits play a significant role in establishing the team. Another participant sees personal traits as a gateway for getting disciplinary competences into play. The participant stated that, “It is no use that you are super deep in your disciplinary knowledge if you are not able to be part of a team”. Another participant asserted that 45% importance is placed on disciplinary competences, and 55% importance is placed on personality, and furthermore stated the importance of being able to fit into the team. However, it is also stressed that situations differ, and the above distribution may be inaccurate; disciplinary depth may weigh more heavily concerning certain types of problems. A third participant agreed that personal traits are important for interdisciplinary teamwork and sees the influence of personal traits as an important factor for creating fruitful dynamics in a team. “Personally, I think personal traits are really important. Of course, disciplinary knowledge is important but overall, I would say that personality is important, and there is no doubt […] that when you can give each other a hug or a pat on the back, you can also more easily […] push for a task to be done [...]”. A

central goal is creating a space where everyone feels comfortable, as well as creating an agenda that all group members identify with. This becomes part of creating a common language within interdisciplinary groups.

The nature of interdisciplinary competences is complex, and participants focused on various areas. For example, one participant stressed that patience is surprisingly important and something that can be learned (by necessity). “When you have worked in different places, as I have, then you learn that patience is a virtue. You might think that you have reached your limit, but you never have.” Cultural awareness and practices, it seems, factor highly and the same participant focused on this topic a lot. It is furthermore noted that cultural context matters more than some might think: “It [aware of others’ abilities] is something we do well in Denmark; a cleaning lady may provide good ideas as easily as anyone else. We understand that everyone has an opinion and can contribute. Sometimes we mustn’t think that just because we have a particular degree then we’re smart.” Another participant touches on the same topic but focused on the importance of making people function together on an interpersonal level before they can collaborate on a professional level. “My experience is that if you can get people to play together, then you’re also creating trust and relations which you can later build upon further. That works really well.” There seems to exist a relationship between personal traits and interdisciplinarity. The starting point remains the discipline and educational background itself, but in order to make complex interdisciplinary collaboration really *work*, certain personal traits are necessary. This, as it turns out, also significantly and positively influences problem-solving potential and continued learning for individual employees.

3.3 Personal traits and interdisciplinarity

While disciplinary knowledge is required and valued, certain personal traits were contributing factors that significantly influence (interdisciplinary) collaboration. Speaking of a colleague with a different professional background, one participant articulated how their colleague showed engagement and became (more) valuable. “[h]e really has developed [professionally]; he has acquired new knowledge, was curious, has learned, observed, and delved into sustainability […] I did not have the same experience. In the beginning, it [collaborating] was difficult because we didn’t know each other.” Participants generally reported that feeling a sense of connection or common purpose was crucial for interdisciplinary collaboration. While it is possible to collaborate with strangers with whom one feels dissimilar, the consequences of positive relations prior to collaboration are profound. Other participants expressed the same views: “It is important that people accept each other in these roles, and that they want what’s best for each other”. In the same vein, showing a degree of openness and curiosity was clearly beneficial, but participants also articulated the importance of being aware of one’s own disciplinary limits and, therefore, the need to listen and learn. “It is important to contribute with whatever disciplinary knowledge one has. People with the same background talk the same language. It is possible to learn a lot via the experiences other disciplines have, and that’s something I find to

have strengthened collaboration […] by being curious about what the other disciplines deal with, and curious about how what I contribute influences the things they work with." It is quite telling that, when asked if situations exist where interdisciplinary collaboration does not make sense, participants unequivocally (and usually very fast) said no. "No, not at all." However, as noted earlier, it is in this context worthwhile to note that certain departments may benefit more from interdisciplinary collaboration than others.

Ultimately it became clear that personal traits are important in order to make interdisciplinary collaboration function, but articulating precisely how this happens, or which specific competences are necessary, can be difficult. Specific and expected competences were recurring, such as respect, ability to listen, and openness, but participants had some difficulty expressing how exactly this manifested in specific situations. Personality, then, plays a big role but experience with interdisciplinary and other educational backgrounds may enable employees (or students) to broaden their horizons. Understanding that problems rarely only have one single possible solution is the first step in acknowledging that other disciplines may be able to contribute to innovative and unexpected solutions that are also viable.

4 SUMMARY AND ACKNOWLEDGMENTS

The findings have proven valuable and provided productive insight into interdisciplinarity. While the issue of interdisciplinarity is multifaceted and remains context-dependent and complex, our qualitative analysis nevertheless points to certain patterns. For example, the benefits of interdisciplinarity are strongly supported by the participants – regardless of their educational background. The importance of personal traits has been stressed by all participants, and there is strong potential for further research that might map the precise nature of these traits. The outcome of this article provides a starting point that clearly points towards interdisciplinarity being valuable for certain types of jobs, particularly ones that focus on innovation and long-term projects. Consequently, university curricula might be adjusted to better prepare students for what seems to be inevitable interdisciplinary collaboration. In this regard, we also see strong potential for further research; while the current research has tapped into the realities of one particular company, more data collected from other companies may provide new or differing insights as other companies will necessarily exhibit other work cultures, other ways of structuring departments (and consequently collaboration), and other ways of understanding and conceptualizing the issue of interdisciplinarity.

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REFERENCES

[1] Hacklin, F., Wallin, M.W (2013). Convergence and Interdisciplinarity in innovation management. A review, critique, and future directions. The Service Industries Journal, 33:7-8, pp. 774-788.

[2] Borrego, M., & Newswander, L. K. (2008). Characteristics of successful cross-disciplinary engineering education collaborations. Journal of Engineering Education, 97(2), 123-134. (Borrego & Newswander, 2008)

[3] Chen, J., Kolmos, A., & Du, X. (2020). Forms of implementation and challenges of PBL in engineering education: A review of literature. European Journal of Engineering Education, pp. 1-26.

[4] Kolmos, A., Brogaard Bertel L., Egelund Holgaard, J. and Routhe, H. W. (2020). Project Types and Complex Problem-Solving Competencies: Towards a Conceptual Framework. Educate for the Future: PBL, Sustainability and Digitalisation 2020, Guerra A., Chen J., Winther M. & Kolmos A. (Ed.), Aalborg University, Aalborg, Denmark, pp: 56-66

[5] Barry, A., Born, G., & Weszkalnys, G. (2008). Logics of interdisciplinarity. Economy and Society, 37(1), pp. 20-49.

[6] Routhe, H. W., Winther, M., Nguyen, N. T., Holgaard, J. E., & Kolmos, A. (2022), Challenges for engineering students working with authentic complex problems. SEFI 2022 - 50th Annual Conference of the European Society for Engineering Education, Jarvinen H-M., Silvestre S., Llorens A., & Nagy B. V. (Ed.), Barcelona, pp. 1508-1517

[7] Routhe, H. W., Brogaard Bertel, L. and Winther, M., Kolmos, A., Münzberger, P. and Andersen, J. (2020), Interdisciplinary Megaprojects in Blended Problem-Based Learning Environments: Student Perspectives, Visions and Concepts for Education 4.0 - Proceedings of the 9th international Conference on Interactive Collaborative and Blended Learning, Auer M. E., Centea D. (Ed.), MC Master University, Hamilton, Canada. Pp. 169-181

[8] Winther, M., Bertel, L. B., Routhe, H. W., Kolmos, A., Andersen, J. & Münzberger, P. (2020). AAU Megaprojects: An Educational Strategy for Sustainable Development. International Conference on Sustainable Development 2020.

[9] Winther, M., Routhe, H. W., Holgaard, J. E., & Kolmos, A. (2022). Interdisciplinary Problem-Based Projects for First-Year Engineering Students. ASEE 2022 Annual Conference: Excellence through Diversity. Minneapolis, https://peer.asee.org/40898