

# AAU Megaprojects: An Educational Strategy for Sustainable Development

Maiken Winther, Research Assistant, Aalborg University  
Lykke Brogaard Bertel, Associate Professor, Aalborg University (corresponding author)

lykke@plan.aau.dk  
(0045) 29 86 41 54  
Rendsburggade 14  
9000 Aalborg, Denmark

Henrik Worm Routhe, Research Assistant, Aalborg University

Anette Kolmos, Professor, Aalborg University

Jesper Andersen, Master's Candidate, Aalborg University

Patrick Münzberger, Master's Candidate, Aalborg University

## Abstract

### 1. Introduction

With the implementation of the UN's 17 Sustainable Development Goals (SDG's) in 2015, guidelines, visions and common goals for a joined contribution towards a better, more sustainable world have been provided, creating a complex setting for research and practice. Thus, since 2015 educational institutions and companies all over the world have implemented actions to support the development of complex, sustainable problem solving skills and competencies. One such initiative is *AAU Megaprojects*<sup>1</sup>, large scale educational megaprojects implemented at Aalborg University (AAU) to allow students to work in highly complex and interdisciplinary settings, addressing one or more of the 17 SDG's, while still maintaining the timeframe and disciplinary learning outcomes given within specific semesters and programs. Through an expansion of students' contextual and interdisciplinary understanding, the aim of the AAU Megaprojects is for students to develop more complex and holistic approaches to problem solving for the future.

To identify potentials and challenges related to the development and implementation of megaprojects at AAU, processes and outputs from the first two rounds of AAU Megaprojects (fall 2019-spring 2020) have been explored and evaluated. Thus, findings and data presented in this paper derives from observations and interviews conducted as part of this research. In autumn 2019 and spring 2020, approximately 50 students have participated in the AAU Megaprojects, working across faculties and disciplines. Taking point of departure in a theoretical understanding of interdisciplinarity and differences in transversal collaboration as well as experiences and opinions shared by students participating in one or both rounds of the megaprojects, this paper elaborates on institutional challenges, needs and possibilities related to interdisciplinary learning and megaprojects as an educational strategy for sustainable development.

#### 1.1. Problem-based learning: from single-discipline projects to megaprojects

For decades, traditional disciplinary approaches to research and education has shown useful for societal development and progress. Through distinct methodological, epistemological and ontological understandings, researchers have identified and solved practical and scientific problems without necessarily having to question approaches,

---

<sup>1</sup> Aalborg University, "AAU Megaprojects"

language nor the nature of science itself. However, researchers and educators increasingly challenge this approach, arguing it is insufficient for handling complex issues that require a rethinking of the scientific settings of disciplines to strengthen shared understanding and suitable, sustainable, solutions.<sup>2</sup>

Within education, one such advocate is the problem-based learning (PBL) approach, which argues for contextually embedded and authentic, real world problems as point of departure for both single-discipline and interdisciplinary learning. At Aalborg University, a systems approach to PBL has been implemented since 1974, facilitating a student-centered learning environment that provides students with both discipline-specific competences and collaborative skills<sup>3</sup> through authentic problem-oriented project work in smaller groups of 5-7 students.<sup>4 5</sup> However, the increasing complexity of both academic, technical and societal issues calls for more diversity in both problem-approaches and project constellations, and the competence to navigate the change from simple discipline projects to highly complex, interconnected and interdisciplinary projects.<sup>6</sup> One such complex setting is found within the field of Sustainability science, rethinking interactions and collaboration among disciplines at scale, combining ecological, economic and societal components to create diverse knowledge and skills, and thus acting both as the goal but also as an ideal, a sub-discipline and an umbrella.<sup>7</sup>

## **1.2. AAU Megaprojects: A way to achieve the Sustainable Development Goals?**

The AAU Megaprojects has evolved from an institution-wide wish to enable students to collaborate across disciplines on highly complex projects to improve both discipline-specific and transversal skills and competences for the future. In this context, the Sustainable Development Goals act as indicators and a contextual framework for large-scale interdisciplinary projects across departments and faculties. Each megaproject spans a duration of 2-3 years, structured as an umbrella project framing a thematic setting for a shared field of interest. The first megaproject was launched in September 2019 and so far, two megaprojects are running: "*Simplifying Sustainable Living*" and "*The Circular Region*".<sup>8</sup> To exemplify the internal, scalable, structure of a megaproject, Simplifying Sustainable Living (figure 1) is organized in three sub-themes (*focus areas*) further specified in up to two *challenges* each. Each challenge can contain a number of *clusters* (each containing up to five student groups). The spring semester of 2020 had five challenges running divided between the two megaprojects (of this three groups have been single-student "teams" of master students). For Simplifying Sustainable Living three clusters have been divided with two challenges: "*Eat Sustainably*" and "*Demolition Waste*". In the initial phase of the megaproject, each student group has chosen a challenge of interest and been distributed in clusters based on an initial project idea and description.

---

<sup>2</sup> Stock and Burton, "Defining Terms for Integrated Sustainability Research"

<sup>3</sup> Kolmos and de Graaff, "Problem-based and project-based learning in engineering education"

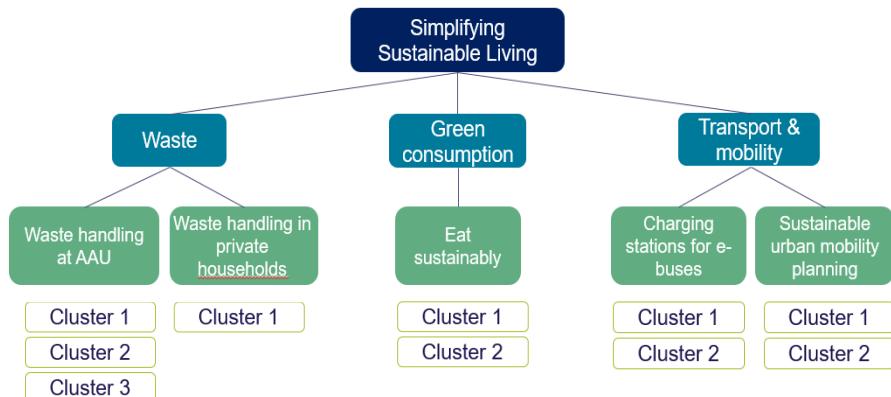
<sup>4</sup> Askehave et al., "PBL: Problem-Based Learning"

<sup>5</sup> de Graaff and Kolmos, "History of Problem-Based and Project-Based Learning"

<sup>6</sup> Kolmos et al., "Project Types and Complex Problem-Solving Competencies"

<sup>7</sup> Stock and Burton, "Defining Terms for Integrated Sustainability Research"

<sup>8</sup> Aalborg University, "AAU Megaprojects"



*Figure 1. The AAU Megaproject Simplifying Sustainable Living*

To ensure that the megaprojects are in fact interdisciplinary, each theme is assessed by an interdisciplinary group of faculty members and further developed in collaboration with private and public stakeholders to ensure that themes, focus areas and challenges are authentic and relevant. It is a requirement, that a megaproject is relevant for at least four faculties, whereas focus areas must be relevant for at least three faculties. Challenges must be relevant for at least two faculties, one in addition to the faculty hosting the particular megaproject. Joining a megaproject is not compulsory and thus considered extra-curricular, however the majority of megaproject activities work in tandem with program specific activities and are fully credited in semester projects. Through this structure, it is possible for the students to take part in interdisciplinary and large-scale collaborative work while still maintaining the timeframe and learning outcomes given within specific semesters and programs.<sup>9</sup>

To promote interdisciplinary collaboration among the participating groups, a number of joint products and collaborative activities are organized throughout the semester. These include a minimum of two seminars, four deliverables and participation in an online SDG module. All activities in the clusters are intended to be student-led, organized and coordinated by students to facilitate collaboration and a joined contribution for the AAU Megaproject conference at the end/beginning of each megaproject period. The aim of the seminars is to share and synthesize preliminary findings and problem analyses with deliverables contributing to ongoing reflection and knowledge sharing within the groups, while the online module contribute with a common framework for approaching the SDG's. At the megaproject conference, the participating clusters present their joint contribution to knowledge and solutions to stakeholders, invited researchers and potential future participants, serving as a kick-off for the next megaproject semester.

To provide each cluster with a platform for communication and information sharing, a digital space for online collaboration is formed before the cluster formations. In the fall of 2019, Moodle was used as a platform, whereas a transition to Microsoft Teams was initiated by spring 2020. One group worked explicitly with an external stakeholder who also had access to this forum, providing the students with knowledge required to collectively identify and analyze relevant problems.

---

<sup>9</sup> Aalborg University, "AAU Megaprojects"

## **2. Interdisciplinarity in problem-based learning: A conceptual framework**

A significant element in the AAU Megaprojects is the interdisciplinary approach to student learning. By letting students work across disciplines and paradigms, their collaborative competences are strengthened as they co-construct and integrate knowledge into a shared understanding of a common issue. In the literature, different approaches and concepts have been used to describe the cross-disciplinary field or ‘integrated research’, one key barrier being a lack of common language and understandings of what the term means across disciplines, thus creating space where the term is used, and changed, differently depending on the discipline.<sup>10</sup>

The interdisciplinary approach to research and education stems from the need to address the interface of problems from ever-evolving human and natural systems, thus previously interdisciplinary fields may be considered disciplinary today, with own epistemological and ontological foundation and methodological approaches.<sup>11</sup> The driver for interdisciplinary studies is exogenous, i.e. the complexity of the problem defines how to approach it.<sup>12</sup> Meanwhile interdisciplinarity is the most common term used to describe integrated research, other terms have been used to try and embrace the diverse range of stages in interdisciplinary research, ranging from; *borrowing* to *multidisciplinarity*, (narrow and broad) *interdisciplinarity* and *transdisciplinarity*.<sup>13 14</sup>

- *Borrowing* refers to the use of methods, theories and skills originated from a different discipline with no other interaction with the field. In PBL, this is a natural part of the identification and analysis phases of a problem-oriented project.<sup>15</sup>
- *Multidisciplinarity* refers to research where one or more disciplines produce individual contributions to a common goal. Often project driven, researchers investigate a field or problem of interest through a thematic frame, sharing knowledge and facilities though with no attempt to cross the disciplinary boundaries, thus providing needed expertise without necessarily facilitating synergies and competences qualifying researchers to elaborate and generate new questions and perspectives on an issue. In PBL, multidisciplinarity is often seen in bigger courses, or clusters of sub-disciplinary courses or projects characterized by a number of project groups working in parallel on the same or complementary elements (work packages).<sup>16</sup>
- *Interdisciplinarity* refers to settings that enable iterative processes of defining and redefining problems in more complex and often ‘real-world’ settings, pushing participating researchers to create new knowledge through crossing disciplines and paradigms and examining existing knowledge and approaches. Participants must agree on a joint focus on a problem, common methodologies and analysis tools adding complexity to the collaborative processes from one researcher joining another discipline to large groups of different disciplines learning to communicate and collaborate. In interdisciplinary projects, a distinction is often made between

---

<sup>10</sup> Stock and Burton, “Defining Terms for Integrated Sustainability Research”

<sup>11</sup> National Academy of Science, “Facilitating Interdisciplinary Research”

<sup>12</sup> Klein, “A taxonomy of interdisciplinarity”

<sup>13</sup> Stock and Burton, “Defining Terms for Integrated Sustainability Research”

<sup>14</sup> Klein, “A taxonomy of interdisciplinarity”

<sup>15</sup> Kolmos et al, “Project Types and Complex Problem-Solving Competencies”

<sup>16</sup> Kolmos et al, “Project Types and Complex Problem-Solving Competencies”

- 'big' and 'small' settings<sup>17</sup> or 'narrow' and 'broad' interdisciplinarity<sup>18</sup> referring to the degree to which collaborating disciplines are inherently distant to one another, i.e. small/narrow interdisciplinary collaboration occurs between disciplines within shared or closely related knowledge paradigms, whereas big/broad interdisciplinary collaboration happens across knowledge paradigms and scientific approaches. In PBL, both narrow and broad interdisciplinarity occurs, especially between courses, however broad interdisciplinarity can be difficult to integrate while also meeting the learning outcomes defined in formal curricula, thus is often limited to extra-curricular projects like case competitions and hackathons. In this context, the AAU Megaprojects is an attempt to integrate interdisciplinarity at varying levels, i.e. allowing for both narrow interdisciplinarity within clusters and challenges while requiring broad interdisciplinarity in focus areas and themes.<sup>19</sup>
- Finally, *transdisciplinarity* refers to the integration of a variety of disciplines as well as participatory approaches including 'non-academic participants' in real-world settings. It is also sometimes used to describe the emergence of entirely new interdisciplinary disciplines, such as new educational programs.

Based on this conceptual framework, the vision of the AAU Megaprojects is characterized by addressing sustainability as a complex broad inter- and transdisciplinary thematic branching into subsequent broad or narrow inter-related focus areas and challenges possible for students to engage in while still meeting the demands, leaning outcomes and timeframes outlined in the formal curricula. However, whether the interaction among groups and students within specific challenges in a megaproject is categorized by interdisciplinary or multi-disciplinary collaboration, and to what extent students are aware of and engage with different disciplines, have yet to be examined. Thus, this paper seeks to explore and elaborate on the current degree of interdisciplinarity in AAU Megaprojects, particularly from the perspective of the students to evaluate its potential as an educational strategy for sustainable development.

## **2.1. Facilitating interdisciplinary collaboration**

Regardless of whether the context is sustainability or something else entirely, adopting an interdisciplinary approach in research and education requires facilitation. Previous structures and understandings must be broken down to create space for meetings and interaction across disciplines.<sup>20</sup> Thus, whereas the setting and problem defines the complexity and level of interdisciplinarity, other factors play into the success of an interdisciplinary collaboration. This includes the size and stability of the team (i.e. ad hoc or stable teams), the degree to which a common understanding is established through shared information, communication and articulation of language, methods and approaches to bridge disciplines<sup>21</sup> as well as motivation and individual willingness to succeed. Interdisciplinary teams should be result driven and work towards challenging goals, thus the interdisciplinary teams should have clear roles with strong leadership, creating mutuality and interdependence. The team should be able to handle conflicts and create an atmosphere where feedback is part of the process.<sup>22</sup>

---

<sup>17</sup> Stock and Burton, "Defining Terms for Integrated Sustainability Research"

<sup>18</sup> Klein, "A taxonomy of interdisciplinarity"

<sup>19</sup> Kolmos et al, "Project Types and Complex Problem-Solving Competencies"

<sup>20</sup> Klein, "Interdisciplinary Teamwork"

<sup>21</sup> National Academy of Science, "Facilitating Interdisciplinary Research"

<sup>22</sup> Klein, "Interdisciplinary Teamwork"

On an organizational level, interdisciplinary research and education needs to be rewarded. For institutions to be able to adopt new policies and procedures, funding is required to create new infrastructure between disciplines and practices and time is needed for new cultures, language and communication to evolve.<sup>23</sup> In real-world settings, interdisciplinary teams materialize and dissolve in response to emerging problems in an open system fluid over time. Thus, when designing for interdisciplinarity in a learning outcome-based educational setting, even with the inherent fluidity of project- and problem-based learning, facilitation is needed as well as continuing examination of potentials and barriers for interdisciplinary collaboration within the system. In this way, implementing and facilitating AAU Megaprojects is an interdisciplinary and complex (mega)project in and of itself.

### **3. AAU Megaprojects in practice: Research Design and Methods**

To identify potentials and challenges related to the development and implementation of megaprojects at AAU, processes and outputs from the first two rounds of AAU Megaprojects have been explored and evaluated. The empirical data for this research was collected in the period from January to July 2020 with approximately 50 students participating in total. Data from the first round of megaprojects in 2019 includes observations from face-to-face endterms and physical Megaproject Conference (February 2020) as well as focus group and individual follow-up interviews with participating students who have experienced a full semester of activities related to a megaproject, including assessment and exams. For the second round of megaprojects starting February 2020, data includes observations of meetings with facilitators and stakeholders as well as observations of midterms in April 2020, all conducted online on MS Teams due to the restrictions of the Covid-19 pandemic. Additional interviews have been conducted with five groups after the semester projects finished in June with 18 students. Thus, while the two Megaproject periods are similar in nature and comparable in terms of goals and purpose of activities, they are fundamentally different in practice and not necessarily directly comparable. Due to Covid-19, the megaproject activities in spring 2020 have been fully virtual, (using MS Teams) whereas the setting in fall 2019 was in-person and blended (using physical meetings and Moodle). The intention of this paper is not to compare the two rounds of megaprojects but to elaborate on experiences and thoughts related to students' participation in a megaproject and experiences of interdisciplinarity. Findings specifically related to digital interaction and collaboration in large-scale educational projects such as AAU Megaprojects have been reported elsewhere.<sup>24</sup>

A total of seven clusters of student groups (two in 2019 and five in 2020) have participated so far, divided between two megaprojects; '*Simplifying Sustainable Living*' and '*The Circular Region*'. In each cluster, up to four groups have collaborated represented from all faculties at the university, except health science. However, the diversity in each cluster have been fairly limited in these first two rounds, as onboarding of students have been voluntary so far, with several groups from similar programs and scientific paradigms such as Communication and Digital Media and Sociology working on the same topic. Additional data include documents such as the project deliverables, syntheses and conference posters as well as weekly meetings with the AAU Megaproject administrative manager. Covid-19 forcing the students to meet and interact online only has made it possible for researchers to observe most interaction among student groups in the clusters, with challenge facilitators and organizers, however with limited means of interacting directly with the students for in-situ interviews in these settings.

---

<sup>23</sup> National Academy of Science, "Facilitating Interdisciplinary Research"

<sup>24</sup> Routhe et al., "Interdisciplinary Megaprojects in Blended Problem-Based Learning Environments"

## **4. Findings**

In this section, empirical data from observations and interviews will inform the analysis of the interdisciplinary setting as it is experienced by students so far. Based on the conceptual framework for integrated research and learning as well as the indicators for adopting and managing interdisciplinary approaches to education, this section will elaborate on the present setting of the AAU Megaprojects and propose suggestions for facilitating an integrated setting across faculties and disciplines for megaprojects as an educational strategy for sustainable development. Findings will take point of departure in the interviews conducted with students participating in the spring semester 2020 supplemented by data from observations during spring 2020 and interviews made with students participating in the fall of 2019.

### **4.1. Megaprojects as an interdisciplinary setting**

When asked what their motivation was for joining the megaprojects, the majority of the students responded sustainability and the opportunity to collaborate with students from other disciplines. Furthermore, the possibility of working with real-life problems, engaging with external stakeholders and participating in something ‘bigger’ was described as a motivation to participate in a megaproject, with the added complexity of interdisciplinarity and sustainability being what distinguishes megaprojects from regular semester projects. Thus, the students’ initial approach and expectations towards their work and goals in the megaprojects were aligned with the overall intention with the megaproject setting.

As mentioned earlier, different joint products and collaborative activities were organized to further enhance the interdisciplinary setting for the students. The purpose of the megaproject conference, midterm and endterm seminars as well as the deliverables were to help the students in framing and connecting their individual semester projects into the interdisciplinary megaproject framework and align these according to other groups in the clusters and challenges. When asked about their experiences with these products and activities, students from both rounds of megaprojects identified certain challenges and expressed some frustration related to the fulfillment of their expectation towards these. For instance, whereas the midterms are set in place to help students align projects and define common goals and contributions, students experienced these as more of a ‘status’ or reporting of information only, with little integration of the shared knowledge in individual projects moving forward. One student mentioned a wish for the seminars to create more common understandings and discussion related to the topic of the megaproject and to sustainability in general, and several groups expressed difficulties in linking project findings and helping other groups with input and suggestions. This is supported by observations made during those same midterms. Whereas students were capable of presenting state-of-the-art knowledge and preliminary findings to each other, they seemed unsure of the overall aim of the sessions and how to integrate the presented knowledge into their own and each other’s work. Several clusters expressed that the goal of the sessions was too much to cope with in one sitting, and decided to divide the midterm into two sessions (a presentation part, and a discussion part) with some days in between, enabling the students to elaborate and reflect upon the information given in the first meeting, before making suggestions for integration in the second meeting. The students generally viewed this as a successful approach, especially one cluster found a rhythm in this structure of using the first meeting as knowledge sharing and the second meeting as a “working-meeting” to find common ground in their problem statements. This cluster also seemed more motivated to work on the joined deliverable, which they felt helped frame and guide the meeting and thus argued for more of these to help bridge the groups further.

This cluster was also to a greater extent aware of and communicating about the interconnectivity of their projects and “missing” knowledge and disciplines in their cluster, arguing that specific disciplines outside their own could have contributed to the topic within their specific challenges and to the megaproject in general. However, when asked about the impact of deliverables, most other groups and clusters found it to have weak or no impact at all on their own projects. One group found the first deliverables relevant in framing their initial thoughts and ideas, though the later deliverables were too loosely structured to generate input precise enough from other groups. Another group experienced that their project was ahead of the deadlines for the deliverables creating a situation where the deliverables were more a form of extra documentation rather than a tool to help form the project or facilitate integration of new knowledge.

The same group found it hard to do the joint deliverables because of limited communication between the groups. Due to the fact, that communication mostly happened online through Microsoft Teams, it was possible to observe how and to what extent communication and interaction occurred among the groups. Here we observed that this space was particularly active for communication and information sharing before and just after the midterm seminar. In this period, the different groups in the clusters scheduled meetings, shared literature and communicated across the disciplines. However, in the remaining project period after the midterm, the interaction decreased greatly in all clusters. Some groups tried to reach out for a joint meeting, however often with little or no response from the other groups in the cluster. It is difficult to assess whether this might be due to other challenges related to covid-19 restrictions and the pressure of emergency remote teaching in general, however it points to a specific need for ongoing facilitation of communication throughout the project period. This aligns with the overall impression from interviews with students from both fall 2019 and spring semester 2020 expressing a need and wish for more guidelines and facilitation. All students are assigned a semester project supervisor; however, this new interdisciplinary setting can be confusing for the students, making it difficult for them to take immediate ownership of the project as they usually would in a regular semester project.

#### **4.2. Interdisciplinary facilitation in a megaproject**

As mentioned earlier, the organization of the megaprojects as partly extra-curricular (but credited in existing semester projects) requires the students to facilitate and coordinate much of the collaboration in the clusters themselves and through that also establish and agree upon the guidelines needed, which poses a certain challenge simply because it is new to the students. One student mentioned that this “self-directed facilitation” was possible only if the students had the right tools and methods for it, e.g. team roles, leadership skills and communication tools. All competences that these students express in regular semester project but seem particularly challenging or missing in this setting.

Comparing these findings to the conceptual framework for interdisciplinary and integrated learning, this point to different aspects of potentially improving the facilitation of the megaprojects. One aspect is the evident differences between the processes related to the identification and analysis of interdisciplinary problems to work on. Whereas an interdisciplinary collaboration is usually based on naturally emerging problems and incorporating iterative processes of aligning and creating common methodological, epistemological and ontological guidelines, this has not been the case in the current megaprojects. Interdisciplinary groups of faculty have defined the focus areas and challenges within the megaprojects, but the students themselves had not taken much part in the processes of identifying and negotiating project goals and processes. The one

cluster that did implement steps to align and combine problem statements and workflows by splitting up ‘reporting’ and ‘work’ phases of the projects, seemed more positive towards the process of the megaprojects and seemed to have found a certain alignment in the cluster. Thus, this might be a suggestion to facilitate more alignment earlier in the megaproject, i.e. both at kick-off and in the initial phases leading up to the midterm seminar to facilitate more interdependency in the clusters.<sup>25</sup> It is important here to note, that the cluster that managed to do this themselves to a certain extent, where also closely related in terms of disciplines (all within the same scientific paradigm). Thus, scaling up from a more narrow interdisciplinary (or multidisciplinary) setting to that of a more broad one might be a way of gradually increasing interconnectivity between projects and disciplines in the initial phases of introducing educational megaprojects as a strategy for sustainable development. However, with a mainly multidisciplinary or narrow interdisciplinary setting, students’ expectations might not be met with regard to collaboration and impact of the projects. This might affect motivation to take part in megaprojects as most students emphasized complexity, sustainability and interaction with external stakeholders and society as the main motivation for engaging in megaprojects, all aspects aligned with broad interdisciplinary and transdisciplinary approaches to project work.

In addition to the limited communication among the participating groups, some groups emphasized a need for more leadership in the clusters with clear roles and guidelines for facilitating, coordinating and organizing the teamwork in the clusters. One group experienced the start-up phase of the megaproject as simply being placed in a cluster with ‘theoretical’ structures that were not put into practice and respected by other groups. In addition, some students felt the organizational structures were inhibiting for collaboration across the disciplines in the clusters, emphasizing overlapping dates, timelines and deadlines across programs as particularly challenging for interdisciplinary collaboration. This point to a need for faculties to coordinate and collaborate more to ensure that megaproject activities and structures do not conflict or compete with local structures and activities at individual departments and programs. In relation to this, several students pointed to a need for more supervision particularly in relation to integrating discipline-specific and theoretical knowledge into the overall topic of the megaproject and sustainability in general, to provide feedback on the deliverables, and to help students adjust projects according to common findings and outcomes. In one cluster, the ‘challenge proposer’ took more actively part in this process, e.g. participating in initial meetings with stakeholders and joining the midterm to give feedback on individual projects as well as the joined deliverable, and the students generally found this helpful. Thus, a suggestion would be to allocate more time both for ‘challenge proposers’ to attend these collaborative activities and for supervisors to network and coordinate between them as well.

Finally, whereas most clusters were more or less scientifically aligned in terms of research paradigms, research epistemology and methodologies, the few clusters that did have groups or students with diverse backgrounds (such as engineering and humanities) experienced challenges related to culture and academic language, with scientifically similar groups being “easier to talk to” when working on similar problems. This points to a need for particularly broad interdisciplinary and transdisciplinary clusters to implement measures for articulating background, approaches, methods and language to ensure common ground early on in the project period.

---

<sup>25</sup> Routhe et al., “Interdisciplinary Megaprojects in Blended Problem-Based Learning Environments”

## **5. Conclusions and Future Work**

In this paper, findings from the first two rounds of the AAU *Megaprojects* have been presented and related to conceptual frameworks for understanding interdisciplinarity as an educational setting and strategy. The paper identifies potentials and challenges related to the development and implementation of large-scale collaborative and interdisciplinary problem-based projects, particularly related to the interdisciplinary setting and facilitation. We have identified challenges related to fully self-directed and student-organized interdisciplinary collaboration creating an uncertainty and a wish for more structural guidance otherwise usually undertaken by students themselves in regular PBL semester projects. With the present megaproject structure, students are lacking the means and competences to facilitate and manage the complex teamwork setting in the megaprojects, resulting in reduced collaboration and limited interdisciplinarity (leaning towards multidisciplinary or even just borrowing from disciplines) rather than integrated research and learning. Furthermore, preliminary findings indicate that organizational structures within the megaproject influence students' experiences of interdisciplinarity and the overall success of the megaprojects. Thus, whereas megaprojects have the potential to facilitate new collaborative and interdisciplinary competences, including communication and leadership skills, findings indicate that students need guidance and structures to develop the necessary competences to manage such complex collaborative teamwork. This calls for new means of facilitation and methods of support, particularly in early stages of the project as well as institutional anchoring and recognition of the megaprojects from facilitators and supervisors.

This research is ongoing and next steps include evaluating adjustments and suggestions made for the next round of megaprojects in the fall of 2020, as well as integrating the experiences of challengers and supervisors and the importance of transdisciplinary collaboration with external stakeholders in a post-pandemic world. Furthermore, future work includes research on assessment of complex problem-solving and transversal skills in megaprojects, both from the perspective of supervisors and by leveraging emerging technologies such as AI and learning analytics. Finally, future research includes investigating the potential for scaling-up on levels of interdisciplinarity and complexity both in terms of project size and distribution of disciplines, to explore the potential global impact of educational megaprojects as a strategy for sustainable development.

## **6. References**

- Askehave, I., Prehn, H. L., Pedersen, J., & Pedersen, M. T. (Eds.). 2015. *PBL: Problem-Based Learning*. Aalborg: Aalborg University.
- de Graaff, E. and Kolmos, A. 2007. History of Problem-Based and Project-Based Learning. In de Graaff, E. and Kolmos, A. (eds). *Management of Change*, 1-8: Sense Publishers Rotterdam, Netherlands.
- Klein, Julie T. 2010. *A taxonomy of interdisciplinarity*. In: Julie Thompson Klein & Carl Mitcham (eds.). *The Oxford Handbook of Interdisciplinarity*. Oxford University Press
- Klein, Julie T. 2005. *Interdisciplinary Teamwork: The Dynamics of Collaboration and Integration*. In Sharon J. Derry et al (eds). *Interdisciplinary Collaboration, An Emerging Cognitive Science*. Psychology Press. New York. USA.
- Kolmos, A., Brogaard Bertel L., Egelund Holgaard, J. and Routhe, H. W. 2020. *Project Types and Complex Problem-Solving Competencies: Towards a Conceptual Framework*. IRSPBL2020.

- Kolmos, A., & de Graaff, E. 2014. *Problem-based and project-based learning in engineering education*. Cambridge handbook of engineering education research, 141-161.
- 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*. ICBL2020. (Accepted/In Press).
- Stock, P. and Burton, R. J. 2011. *Defining Terms for Integrated (Multi-Inter-Trans-Disciplinary) Sustainability Research*. Sustainability, 3, 1090-1113. ISSN 2071-1050.
- The National Academy of Science. 2005. *Facilitating Interdisciplinary Research*. The National Academies Press. Washington. USA.
- AAU Megaprojects, <https://www.megaprojects.aau.dk/> last accessed 2020/05/19