



Aalborg Universitet

AALBORG UNIVERSITY
DENMARK

Student groups as ‘adhocracies’ – challenging our understanding of PBL, collaboration and technology use

Ryberg, Thomas; Sørensen, Mia Thyrrø; Davidsen, Jacob

Published in:
7th International Research Symposium on PBL

Publication date:
2018

Document Version
Accepted author manuscript, peer reviewed version

[Link to publication from Aalborg University](#)

Citation for published version (APA):

Ryberg, T., Sørensen, M. T., & Davidsen, J. (2018). Student groups as ‘adhocracies’ – challenging our understanding of PBL, collaboration and technology use. In S. Wang, A. Kolmos, A. Guerra, & W. Qiao (Eds.), *7th International Research Symposium on PBL: Innovation, PBL and Competences in Engineering Education* (pp. 106-115). Aalborg Universitetsforlag. International Research Symposium on PBL

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- ? Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- ? You may not further distribute the material or use it for any profit-making activity or commercial gain
- ? You may freely distribute the URL identifying the publication in the public portal ?

Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.

Student groups as ‘adhocracies’ – challenging our understanding of PBL, collaboration and technology use

Thomas Ryberg¹, Mia Thyrrre Sørensen², and Jacob Davidsen³

^{1 2 3} Aalborg University, Dept. of Communication and Psychology, Denmark, ryberg@hum.aau.dk, mts07@hum.aau.dk, jdavidsen@hum.aau.dk;

Abstract

In recent literature, socio-cultural scholars have argued that new forms of organising work within and across organisations are emerging. Engeström (2008) describes it in terms of ‘from teams to knots’ and in a recent book Spinuzzi (2015) explores how some forms of work are carried out, not in stable teams inside an organisation, but rather as temporary convenings or ‘adhocracies’ that are formed dynamically around projects, to quickly disband and take their skills to new projects when the project ends. The value of these adhocracies (or their ‘edge’) relies on their ability to form links both inside and outside an organisation. Both accounts analyse how teams are becoming more dynamic, multidisciplinary and need to work across organisational, as well as geographical boundaries in quickly changing configurations of people. Spinuzzi, further argues how these changes are associated with new and emerging digital technologies, and how these technologies change how we communicate, coordinate and collaborate. In this paper, we critically discuss these conceptualisations in relation to long-term group work within the frame of problem and project-based learning, as it is organised for example in Aalborg University. We explore what these changes might mean for the competences students should acquire in relation to collaboration and working in teams, and how this might impact on our understanding and design of problem and project based learning.

Keywords: Problem and Project Based Learning, digital technologies, collaboration, adhocracies

Type of contribution: research paper or conceptual paper.

1 Introduction

In recent literature, socio-cultural scholars have pointed to changes in how new ways of organising work are emerging within and across organisations. In his book ‘All edge: inside the new workplace networks’ Spinuzzi (2015) is exploring how stable organisational teams and divisions are increasingly supplemented by agile, multidisciplinary, temporary teams that help organisations think and work across boundaries and tackle complex problems that require drawing on different disciplinary skills and competences within an organisation. These changes are also reflected in professional engineering practice and engineering education, where there is an increasing awareness of the need for transversal competences. While transversal competences are increasingly being recognised it is also clear that such skills are needed due to the rising need for working in interdisciplinary teams:

“Presently, one of the major developments in engineering professions is the invention of integrated product teams (IPT) and integrated product development (IPD), where processes of design, manufacturing and marketing are integrated by bringing together interdisciplinary groups (including customers)” (Guerra, Ulseth, Jonhson, & Kolmos, 2017, p. 1225)

These changes and challenges resonate well with Spinuzzi’s claim that stable organisational teams and divisions are increasingly supplemented by agile, multidisciplinary, temporary teams, and Engeström’s conceptualisation of ‘teams as knots’ that need continuous tying and untying in the form of renegotiating

tasks, focus and members. But how does it resonate with how we educate students for their professional and civic life? In this paper, we critically discuss these conceptualisations in relation to long-term group work within the frame of problem and project-based learning, as it is organised for example in Aalborg University. We explore what these changes might mean for the competences students should acquire in relation to collaboration and working in teams, and how this might impact on our understanding and design of problem and project-based learning. We do so by initially presenting problem and project-based learning as it is conceived and practiced at Aalborg University. We use this model as a case in point, but these discussions are equally valid for similar orchestrations of problem and project-based group work. We then introduce the ideas of ‘adhocracies’ and ‘knotworking’ building on the work of Engeström (2008) and Spinuzzi (2015) and we contrast and compare these ideas with how problem and project-based work is organised. We do so by drawing out seven dimensions highlighting differences in how collaboration is perceived from these two perspectives. In the section following, and before the final discussion, we add some nuance to our initial characterisation of problem and project-based learning as practiced in Aalborg University. We conclude by discussing how the seven dimensions identified might be helpful in challenging our current understanding of collaboration within PBL, and how they might help us to conceptualise and design novel PBL models and forms of collaboration.

2 Problem and Project Based Learning - The Aalborg PBL model

In Aalborg University (AAU) a particular PBL model has been employed as a University-wide pedagogical approach since the University’s inauguration in 1974 (Kolmos, Fink, & Krogh, 2004). This model has more recently been formally described in a number of principles (Aalborg University, 2015):

- The problem as point of departure
- Projects organised in groups
- The project is supported by courses
- Collaboration – groups, supervisor, external partners
- Exemplarity
- Student Responsibility for learning

These principles underpin how PBL is practiced at AAU (although with some variance across the different programmes). In practice, this means that students each semester: work in groups; identify their own real-world, societally relevant problems to address (often with external stakeholders); engage in long-term collaboration (3-4 months) where they - together with a supervisor - choose relevant theories and methods; carry out empirical and theoretical studies; analyse and discuss empirical data and/or theories to address their problem. The ‘solution’ to the problem is disseminated in a final project report that accounts for (typically) half of the students’ credit for a semester (15 ECTS). Thus, it is a pedagogical model, which is heavily participant-driven, collaborative and problem-oriented and is inspired by the work in critical pedagogy (e.g. Paolo Freire and Oscar Negt). The model operates at a programme and semester level, rather than being confined to an individual course. This means that the model is implemented at a systemic level where it pervades the organisation of the entire curriculum of an educational programme. This affects the design of relations between courses and project work within a semester, as well as the physical architecture of the university. For example, students should - ideally - have their own group room or space.

It has often been argued – and shown – that this particular pedagogical orchestration is well-suited to support students in acquiring transversal competences such as communication, collaboration, critical thinking and problem-solving skills (Du, Emmersen, Toft, & Sun, 2013; Guerra et al., 2017). While we do not fundamentally

disagree with this, our purpose in this paper is to critically discuss this orchestration of work and highlight some challenges it is facing. For one thing, it is worth noting that students work together in the same group over a lengthy period, and in some cases have access to a group room or group space meaning that the students often work physically co-located. Secondly, while students have other priorities and tasks, their main focus for the extended period of time is the collaboration around a single project where the ‘team’ is stable. Thirdly, although the Aalborg PBL model emphasises interdisciplinarity, it does so mainly through students within a programme adopting theories or methods from different disciplines rather than groups that are formed as inherently inter- or multidisciplinary. While arguably the students are developing very important competences for their future professional and civic life, we would argue that some emerging trends within both work and learning are challenging this particular orchestration of work and suggest that we may need to reflect on how we can develop new forms and models for problem and project-based work, which can *supplement* the existing.

3 Adhocracies and knotworking

In the book ‘from teams to knots’ Engeström (2008) argues how historically new modes of work are emerging and thus changing how we should understand the notion of ‘teams’. Much in line with the previous quotation from (Guerra et al., 2017, p. 1225) he explores how “*processes of design, manufacturing and marketing are integrated by bringing together interdisciplinary groups (including customers)*” through the notion of ‘co-configuration’ adopted from (Victor & Boynton, 1998), and – as we shall return to – the idea of ‘social production’:

“Unlike previous work, co-configuration never results in a “finished” product. Instead, a living, growing network develops between customer, product, and company. (Victor & Boynton, 1998, p. 195)

Engeström defines six criteria of co-configuration work as an emerging new form of work and production: “(1) an adaptive product or service; (2) a continuous relationship between the customer, product/service, and company; (3) ongoing configuration or customization; (4) active customer involvement; (5) multiple collaborating producers; and (6) mutual learning from interactions between the parties involved.” (Engeström, 2008, pp. 195–196). In such a landscape, Engeström argues, the notion of relatively stable teams with clear boundaries becomes problematic, if not obsolete (p. 192), and suggests that stable teams might be just one type of collaboration among a multitude of more fluid forms (p. 194). Further, he discusses how such teams are increasingly internetworked, global or virtual teams whose collaboration are mediated by digital technologies. In understanding how such teams learn and collaborate, Engeström turns to the notions of ‘knots’ and ‘knotworking’:

“The notion of knot refers to rapidly pulsating, distributed, and partially improvised orchestration of collaborative performance between otherwise loosely connected actors and activity systems. Knotworking is characterized by a movement of tying, untying, and retying together seemingly separate threads of activity.” (Engeström, 2008, p. 194)

What we notice here, is how the locus of collaboration and learning moves away from being primarily a property of a stable team towards a notion of collaboration and learning that explores improvisation and the bringing together of loosely connected actors and activities where there is no ‘center’ of activity. This form of collaboration Engeström further explores through the notion of ‘social production’ or peer-production, which are forms of collaboration existing outside formal organisations and are (often) oriented towards production of ‘public goods’. To exemplify such types of production Engeström refers to open source

development, the free science movement and Wikipedia. These are forms of collaboration, which have also been referred to as mass-collaboration (Ryberg, 2018 in press). Mass collaboration is a more diffuse, uncoordinated mass of people contributing individually or in clusters to sustained or more ephemeral constructs. Examples of sustained mass collaborations could be open source development communities or the distributed maintenance and development of Wikipedia pages. However, they can equally be of a more ephemeral nature where there is a short-lived activation of massive participation across many networks. For example, multiple people congregating around a particular hashtag on social media, such as #metoo to debate, share, illustrate gender inequality and sexual harassment. In both cases, the notion of ‘collaboration’ does seem to become a bit stretched, but the examples illustrate emerging forms of orchestrating ‘working together’ via diffuse networks mediated by digital technologies.

Particularly, the aspects of digitally mediated collaboration, coordination, and communication are brought to the fore in Spinuzzi’s (2015) idea of all-edge adhocracies. Spinuzzi studies and analyses how small contractors work and show how these contractors, which are in reality often one-person firms, take on larger projects of e.g. website development, but then dynamically and ad-hoc bring together a distributed team of people to tackle the concrete project; thus, they are able to:

“[...] able to rapidly link across organizational boundaries, combine into temporary work groups, swarm a project with a team of specialists, and disperse at the end of the project, often to re-form in a different configuration, with some different members, for the next project” (Spinuzzi, 2015, p. 2)

This is a form of work that is both developing inside organisations, as a way of dealing with the challenges outlined above, but equally a type of work an increasing number of people within the academic workforce are engaging with, as it offers flexibility and self-management over being part of a larger organization. This type of work, Spinuzzi argues, has predominantly been enabled by information- and communication technologies and the ability to coordinate, communicate and collaborate via numerous – often ‘free’ – social media or web 2.0 tools that exist as alternatives to the large corporate groupware or enterprise systems that were previously a condition for engaging in distributed work. Instead, Spinuzzi studies how dynamic teams with shifting membership, create particular and singular *constellations of technologies* (Rossitto, Bogdan, & Severinson-Eklundh, 2014; Spinuzzi, 2015) for the project at hand, and how the ‘project managers’ engage, not with a stable team, but rather a loosely connected ‘knot’ to borrow the term from Engeström, or that which Spinuzzi refers to as all-edge adhocracies. Further, many of these project managers are engaged in simultaneous projects with different constellations of people and technologies. In both these accounts, we see a move away from understanding the ‘core’ of a group or team i.e. their inner dynamics and negotiations, to study rather their relations at the ‘edges’ and how they are related to other ‘knots’. As such, some contrasts and differences start to emerge if we look at the conceptualisations of teams or groups between the Aalborg PBL model and the notions of adhocracies and knotworking.

4 Contrasts and differences

In the following, we draw out some contrasts and differences that emerge from comparing the AAU-PBL group model with the conceptualisations highlighted by Engeström and Spinuzzi. We do so by returning to some of the characteristics previously highlighted in relation to the Aalborg PBL model. In doing so, we are necessarily reducing the variation and complexity underpinning the model, how it is adopted across the university, as well as how students work in practice. We initially highlight and discuss some overarching traits of the model, to which we shall subsequently add more nuance. Further, we stress that we do not see these discussions as related to only this particular model, but equally to other orchestrations of PBL that bears

resemblance to the Aalborg PBL model i.e. a strongly-tied collaboration in smaller groups over an extended period of time focusing on a particular problem and/or project. In this sense we treat the model as a wider example of a 'small-group' model of work and learning (Damşa, 2014).

As we noted, the PBL - or small-group model - rests on students working on a single project, in a stable, monodisciplinary group over an extended period (3-4 months). The work is often co-located with students occupying the same room or space. Their collaboration is strongly tied, and there is a high-level of mutual dependence within the group. In contrast to this, we can glean from Spinuzzi and Engeström's characterisations of work and collaboration that other features of 'team-work' are starting to emerge. These are characterised by unstable or dynamic membership, shorter-lived processes, parallel engagements, and interdisciplinarity. Further, the progress is not only driven by the individual group or the center, but rather is fuelled by work at 'the edge' or periphery where multiple strands of activities and actors across different knots continuously need to be tied, untied and re-negotiated. As such, there is no 'center' which is in full control of the direction and development of the work. Rather this is negotiated amongst actors in a wider network. In addition, these forms of work can take place at different levels of scale, where participants can be part of 'greater wholes' or 'mass collaborations' such as developing complex open source software in a larger, distributed network possibly composed of smaller, agile teams.

In the following we draw out some central dimensions of these two types of collaboration and discuss them further:

Expertise – monodisciplinary vs interdisciplinary: In the AAU-PBL model the dominant mode of work is carried out by monodisciplinary groups of students within the same educational programme. While the group can draw on theories and methods from multiple disciplines, they are not as such an interdisciplinary team, and their main objective is not to function as such, but to complete a project within a particular programme/discipline. In contrast, adhocracies and knotworking processes are characterised by being formed as and function as interdisciplinary teams and their capacity to function are dependent on the individual actors bringing their unique perspective into the process and negotiating these with the other members.

Membership and scale of collaboration: stable vs dynamic: In the AAU-PBL model membership in the group and the scale of collaboration is stable throughout the entire process, whereas in processes of adhocracies and knotworking members may dynamically change over time and the scale of collaboration can shift between few members to involving wider and more complex networks. For example, in mass-collaborations participants may join to solve a particular sub-tasks and then leave again, and there may be shifts between working in smaller teams and in wider networks.

Space: Co-located vs distributed: In the AAU-PBL model members are often co-located occupying a shared room/space or convening when possible for large parts of the collaboration. In processes of adhocracies and knotworking participants are often geographically dispersed or engaged in other activities, and thus bound together via digital technologies for large parts of the collaboration.

Decision making: central vs. distributed boundary work: In the AAU-PBL model students have a high- degree of autonomy and decisions are negotiated within the group, whereas in processes of knotworking and adhocracies decision making can be of a more distributed nature reconciling perspectives across different actors and activities i.e. involving more stakeholders than a small group.

Collaborative orientation and dependencies: internal/inward vs edge/outward: In the AAU-PBL model group members are primarily oriented towards their own common project and are highly dependent on the internal

collaboration and coordination in the small-group. In contrast, adhocracies and processes of knotworking are oriented towards the periphery, are dependent on other actors and activities, and their success depends on being able to work at the 'edge' by continuously negotiating with neighbouring activities and crossing boundaries.

Task focus: Singular vs parallel: In the AAU-PBL model the task focus is on the concrete problem-based project work and this is the primary focus. In processes of knotworking and adhocracies there may be multiple, conflicting projects in play or separate activities that need to be tied together.

Temporality: extended and fixed vs shorter-lived or dynamic: In the AAU-PBL model, the collaboration usually is performed within an extended and fixed period of e.g. 3-4 months, whereas in adhocracies and knotworking activities may be shorter-lived bursts, intense and dynamic or take forms where the collaboration lies dormant for a while to re-ignite.

Clearly, contrasting the two illustrate very different types and conceptualisations of collaboration. While there are great learning benefits associated with the small-group PBL model, in terms of developing competences (such as collaboration, critical thinking, problem-solving, problem identification and project management) the AAU-PBL model also favours particular modes of collaboration leaving other areas less explored. In saying so, we should remain conscious that the notions of adhocracies and knotworking are not 'pedagogical models', but analytic observations of patterns of collaboration observed in various organizational and work-related contexts. Nevertheless, these conceptualisations do illustrate glimpses of emerging forms of learning and work in the contexts we wish to prepare students for within engineering education and higher education more broadly. The comparisons can thus provoke us to ask critical questions such as: Do students gain sufficient experience working in interdisciplinary groups? Are students sufficiently prepared to work in contexts with multiple loosely connected stakeholders that are geographically dispersed? Are students able to alternate between working in small-groups and larger networks and in dynamic constellations of people? More broadly we could ask whether the competences acquired through small-group work are applicable and transferable to processes of knotworking and adhocracies? As Engeström argues, small-group work or stable teams might be just one type of collaboration among a multitude of more fluid and dynamic forms of collaboration. The question is whether students gain sufficient experiences and competences with varying types of collaborative engagements?

However, as earlier indicated, we have deliberately reduced the variations and complexities underpinning the AAU-PBL model in these comparisons e.g. how it is differently adopted across the university, and how students work in practice. In the following section, we therefore add some nuance and present examples of practices where students engage in activities bearing some resemblance to processes of knotworking and adhocracies, particularly including their use of digital technologies.

5 Nuances and variations – nomadic groups and digital technologies

For one thing, it is worth noting that many students do gain experiences with interdisciplinary work. Often in Master programmes, the participants come from widely different disciplinary backgrounds, and students have opportunities to engage with events such as case competitions (<http://www.aucasecompetition.dk/>) where they work intensively for two days in interdisciplinary groups to address a challenge or case from an industry partner. Another example is the DADIU event where students from art schools and universities work with interdisciplinary game development during an entire semester (<http://www.dadiu.dk>). Further, there

are examples of semesters where students alternate between small-group work and engaging with the whole cohort as a learning network (Ryberg & Davidsen, 2018).

However, more importantly, we wish to highlight how the daily work of students bear some resemblances to processes of adhocracies and knotworking. Particularly in their use of digital technologies as part of the problem and project-based group work. In a series of studies, we – and others – have investigated students' use of technologies in relation to group work (Guerra, 2015; Khalid, Rongbuttsri, & Buus, 2012; Rongbuttsri, Forthcoming; Rongbuttsri, Khalid, & Ryberg, 2011; Ryberg & Davidsen, 2018; Ryberg, Davidsen, & Hodgson, 2018; Sørensen, 2018; Thomsen, Sørensen, & Ryberg, 2016) and in the following we briefly discuss some of the results and insights.

While students' group work is often co-located, it is at the same time heavily underpinned by digital technologies. In writing and managing their projects, students commonly use Google Docs/Office 365 for collaborative writing; Dropbox/Onedrive for file-sharing; Facebook for internal communication and coordination in the group; MeisterTask or Kanbanflow for project and task management; Skype/Hangouts when they are not able to meet. In this sense, the groups resemble the adhocracies described by Spinuzzi, where they negotiate a *potential constellation of technologies* (Rossitto et al., 2014; Spinuzzi, 2015) for their particular project – a constellation that might change over time as new technologies are brought in, experimented with and adopted or discarded (Rongbuttsri, 2017). This is a process we have previously described as 'the orchestration of multiple technologies' (Ryberg et al., 2018). The constellations of technologies are flexible, dynamic and characterised by adopting 'freely' available social media tools (or the Microsoft tools provided by the institution). They are light, flexible packages composed of several tools rather than 'professional' groupware or enterprise systems (students can even find such solutions cumbersome and overwhelming (Sørensen, 2018)). In this way, students experiment with a variety of digital technologies to support their group work over time and although students tend to cling to particular tools they know, some changes occur over time as students come into new groups and need to negotiate a new constellation of technologies (Sørensen, 2018).

In our studies of groups, we have equally found that many student groups are what we have termed 'nomadic' (Ryberg et al., 2018); these are groups who have no common permanent group room or space, and therefore need to reserve group rooms for shorter periods of time (two hours), work in the hallways, cantina, libraries, cafes or at home. These groups often work in more distributed ways where they alternate between occasional group meetings and working individually coordinating and communicating via their selected communication and collaboration tools. For these groups in particular they continuously engage in the 'orchestration of work phases, spaces, and activities' (Ryberg et al., 2018), where they on a daily basis need to make decisions of where and how to work. Do they need a common, quiet space, can they use the cantina, should they work individually from home and coordinate online? Such decisions are taken ad-hoc in the group and depend also on which phase they are in their project e.g. do they need to discuss the overall direction of the project and write closely together, or can they read the material and write independently? This was also a pattern observed with groups having their own spaces. They would often change constellations and break into smaller groups, do some work and congregate later. As with the nomadic groups their planning of activities and tasks was dynamic and agile and while they do have longer-terms plan for their work, it was also characterised by ad-hoc planning and flexibility depending on the situation at hand. With this, we want to draw attention to the fact that although the groups are stable, and the time-period is fixed, the groups also work and attune themselves to shifting conditions and tasks; break into smaller groups

to work for a period of time on shorter-lived task, untying and tying together again different activities, doing fieldwork, experiments, interviews etc.

In this way, the groups' practical day-to-day work bear resemblance to the adhocracies described by Spinuzzi, and the 'knotworking' together of different strands of activities and actors. We believe this needs mentioning to counterbalance the initial diagnosis that could leave the reader with the impression of PBL group work as a static, stable phenomenon with clearly described roles, functions, tasks. When zooming in on the everyday group work we do see a myriad of knotworking like practices that in many ways – on a micro-scale – function as quite dynamic adhocracies. However, there are some traits of adhocracies and knotworking that are not present in the current practice which are worth exploring to guide reflections on new ways of practicing PBL.

6 Final discussion

In comparing and contrasting the AAU-PBL model (or widely: small-group PBL work) with the notions of adhocracies and knotworking some markedly different dimensions emerge. Dimensions which can provoke critical questions in relation to how we are currently practicing small-group PBL. These are the dimensions of *mono-disciplinarity vs. interdisciplinarity; membership and scale of collaboration; Space - co-located vs distributed; Decision making – central vs. distributed boundary work; Collaborative orientation and dependencies – inward or outward; Task focus: Singular vs parallel; Temporality – extended and fixed vs shorter-lived or dynamic*. Bringing out these contrasts, we can begin to ask questions such as: Do students gain experiences with distributed, interdisciplinary work? Do students gain experiences working in more complex networks of decision making and collaboration where the locus of control is distributed amongst different stakeholders? Do students find themselves in situations where the collaborative orientation and dependencies extend beyond the individual group and into larger more complex networks or mass-collaborations that need to continuously 'knotwork' together different strands of activities and actors? Do students attain experiences with short-burst, intensive forms of mass-collaboration where a large number of participants co-construct, in a distributed manner, a shared 'product' or solution? Are students exposed to working on multiple parallel projects that require coordination amongst several overlapping and conflicting stakeholders?

We do not raise these questions to suggest that the current PBL practice is obsolete and should be completely re-designed. Rather we suggest that we could begin to work with designing modules or semesters that features other forms of collaborative engagements than primarily small-group PBL work. The small-group PBL work does provide students with valuable competences in terms of collaboration, critical thinking, communication, project management etc. and as we have highlighted in the section on nuances and variations, the actual practices of small-group work do carry some resemblance to the notions of adhocracies and processes of knotworking. Students' work is heavily underpinned by a variety of digital technologies and the work is characterised by a certain agility, flexibility and ad-hoc planning encompassing - in a micro-perspective – also processes of knot-working where different actors and activities are tied together. However, particularly the dimensions of decision making, the collaborative orientation, membership and scale of collaboration remain within the boundaries of the (monodisciplinary) group. The groups can be viewed as relatively stable, autonomous units that do not rely on interaction across boundaries. Nor do the individual units' work feed into, or need to be coordinated with, a larger, more diffuse and geographically distributed network of actors and activities. We conjecture that designing for such experiences might strengthen, broaden and extend the collaborative competences students develop through the existing forms of small-group PBL, and we believe the seven dimensions we have identified by contrasting and comparing the AAU-

PBL model with notions of knotworking and adhocracies can be helpful as conceptual tools to design and craft new models and ideas for collaborative engagements that expands the scope of the small-group PBL orchestrations.

References

- Aalborg University. (2015). *Problem Based Learning* (1). Aalborg University. Retrieved from http://www.aau.dk/digitalAssets/148/148025_pbl-aalborg-model_uk.pdf
- Damşa, C. I. (2014). The multi-layered nature of small-group learning: Productive interactions in object-oriented collaboration. *International Journal of Computer-Supported Collaborative Learning*, 9(3), 247–281. <https://doi.org/10.1007/s11412-014-9193-8>
- Du, X., Emmersen, J., Toft, E., & Sun, B. (2013). PBL and critical thinking disposition in Chinese medical students – A randomized cross-sectional study. *Journal of Problem Based Learning in Higher Education*, 1(1), 72–83. <https://doi.org/10.5278/ojs.jpblhe.v1i1.275>
- Engeström, Y. (2008). *From Teams to Knots: Activity-Theoretical Studies of Collaboration and Learning at Work* (1st ed.). Cambridge University Press.
- Guerra, A. (2015). Use of ICT tools to manage project work in PBL environment. In E. de Graaff, A. Guerra, A. Kolmos, & N. A. Arexolaleiba (Eds.), *Global Research Community: Collaboration and Developments* (pp. 445–455). Denmark: Aalborg Universitetsforlag. Retrieved from http://vbn.aau.dk/files/217364094/Global_research_community_collaboration_and_development_final.pdf
- Guerra, A., Ulseth, R., Jonhson, B., & Kolmos, A. (2017). Engineering grand challenges and the attributes of the global engineer: a literature review. In J. C. Quadrado, J. Bernardino, & J. Rocha (Eds.), *Proceedings of the 45th SEFI Annual Conference 2017* (pp. 1222–1235). SEFI: European Association for Engineering Education.
- Khalid, M. S., Rongbutrsri, N., & Buus, L. (2012). Facilitating Adoption of Web Tools for Problem and Project Based Learning Activities. In V. Hodgson, C. Jones, M. de Laat, D. McConnell, T. Ryberg, & P. Sloep (Eds.), *Proceedings of the Eighth International Conference on Networked Learning 2012* (pp. 559–566). Retrieved from <http://www.networkedlearningconference.org.uk/abstracts/pdf/khalid.pdf>
- Kolmos, A., Fink, F. K., & Krogh, L. (2004). *The Aalborg PBL Model - Progress Diversity and Challenges*. Aalborg: Aalborg University Press.
- Rongbutrsri, N. (Forthcoming). *Collaborative Learning Tools - Adoption for Knowledge Construction in Problem-Oriented Project Based Learning* (PhD thesis). Aalborg University.
- Rongbutrsri, N., Khalid, M. S., & Ryberg, T. (2011). ICT support for students' collaboration in problem and project based learning. In J. Davies, E. de Graaf, & A. Kolmos (Eds.), *PBL Across The Disciplines* (pp. 351–363). Aalborg Universitetsforlag. Retrieved from http://vbn.aau.dk/files/57931848/PBL_across_the_disciplines_research_into_the_best_practice.pdf
- Rossitto, C., Bogdan, C., & Severinson-Eklundh, K. (2014). Understanding Constellations of Technologies in Use in a Collaborative Nomadic Setting. *Computer Supported Cooperative Work (CSCW)*, 23(2), 137–161. <https://doi.org/10.1007/s10606-013-9196-4>

- Ryberg, T. (2018 in press). PBL and Networked Learning: Potentials and Challenges in the Age of Mass Collaboration and Personalization. In M. Moallem, W. Hung, & N. Dabbagh (Eds.), *The Wiley Handbook of Problem-Based Learning*. Wiley.
- Ryberg, T., & Davidsen, J. (2018). Establishing a Sense of Community, Interaction, and Knowledge Exchange Among Students. *SpringerLink*, 143–160. https://doi.org/10.1007/978-3-658-19925-8_11
- Ryberg, T., Davidsen, J., & Hodgson, V. (2018). Understanding nomadic collaborative learning groups: Nomadic collaborative learning groups. *British Journal of Educational Technology*, 49(2), 235–247. <https://doi.org/10.1111/bjet.12584>
- Sørensen, M. T. (2018). The Students' Choice of Technology A pragmatic and outcome-focused Approach. In D. Kergel, B. Heidkamp, P. K. Telléus, T. Rachwal, & S. Nowakowski (Eds.), *The Digital Turn in Higher Education* (pp. 161–174). Wiesbaden: Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-19925-8_12
- Spinuzzi, C. (2015). *All edge: inside the new workplace networks*. Chicago ; London: The University of Chicago Press.
- Thomsen, D. L., Sørensen, M. T., & Ryberg, T. (2016). Where have all the students gone? They are all on Facebook Now. In S. Cranmer, M. de Laat, T. Ryberg, & J.-A. Sime (Eds.), *Proceedings of the 10th International Conference on Networked Learning 2016* (pp. 94–102). Lancaster University. Retrieved from <http://www.lancaster.ac.uk/fss/organisations/netlc/abstracts/pdf/P01.pdf>
- Victor, B., & Boynton, A. C. (1998). *Invented Here: Maximizing Your Organization's Internal Growth and Profitability*. Harvard Business School Press.