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6th International Research Symposium on PBL

PBL, Social Progress and Sustainability

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AALBORG UNIVERSITY
Aalborg Centre for Problem Based Learning
in Engineering Science and Sustainability
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PBL, Social Progress and Sustainability
Hosted by Universidad Nacional de Colombia, Colombia, and organized together with Aalborg Centre for PBL in Engineering Science and Sustainability under the auspices of UNESCO, Denmark

Student challenges when learning to become a real team in a PBL curriculum: Experiences from first year science, engineering and mathematics students

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Abstract

This paper analyses the Process Analyses of student groups from three engineering, science, and mathematics programmes to detect the issues students find challenging, how they either have coped with or solved them during the project work, and how efficiency and effectiveness have evolved over the semester. Additionally, we use the Process Analyses to measure the quality of the group work undertaken to identify issues worth addressing e.g. in the PBL course taught during the first semester. We apply the theory of Katzenbach and Smith (1993) to analyse and describe the groups. Based on the analysis, we identify four different types of groups ranging from pseudo teams to high performance teams spanning across all the programmes. Overall, all groups experienced issues such as lateness, distribution of work, different personalities and abilities, conflicts, overview, time management, distribution of work load, knowledge sharing, long time absence due to illness, or drop-out. We also found that some groups could take advantage of their mutual differences, reflectively apply the project management tools they learn in the PBL course, solve the conflicts they experience, and develop their knowledge sharing.

Keywords: PBL, process analysis, student challenges, real teams, high performance teams

Type of contribution: Research paper

1   Introduction

The teaching at Aalborg University (AAU) is organised around the principles of project- and problem-based learning (PBL), and each semester the students spent half the time in groups of usually three to eight students (in the first year, six to eight students) working together on a PBL project relevant to their subject. To aid the students' project work, each group is assigned a supervisor, who acts as a facilitator during the semester and as internal examiner at the exam. The other half of the time, the students attend more traditionally organised courses. The projects are assessed by the end of each semester. As part of the assessment at the first year of study, the groups are obliged to submit a Process Analysis, which is a five-to-ten-page document mainly reflecting on group collaboration, project and knowledge management, and collaboration with the supervisor. This Process Analysis is taken into consideration when determining the students' grades. During the first semester, the students have a 5 ECTS course in PBL providing them with tools for management and reflections regarding the issues mentioned (Mosgaard and Spliid 2011). In this sense, the teaching at AAU is unique. Aalborg University has been an innovator and world leader in problem- and project-based learning in engineering, science and mathematics ever since the beginning. Henceforward, it is of broader interest to scrutinise and reflect upon the educational teamwork experiences that can be extracted from the AAU PBL approach (Kolmos et al. 2004, de Graaff and Kolmos 2007, Barge 2010, Askehave et al. 2015).

The three authors teach the above-mentioned PBL course and act as co-supervisors for student groups from several programmes. Our experience told us that student groups often struggle with challenging issues during the first year of study, although all groups manage to complete and deliver a technical report. Issues are manifold such as students not keeping a deadline or being late for group meetings; dominating students or the opposite, passive or overly social students; conflicts that are not addressed; and working conditions that maintain a high pressure on the group, leading to stress management issues. There are also sometimes problems with supervisors; typically, if students find the supervisor not active enough or too 'bossy'. Another typical group issue is lack of awareness that time management and the ability to prioritise tasks is essential for an efficient group. The students usually learn the hard way that this is essential even though the above-mentioned course introduces them to useful practical and managerial tools. However, the issues mentioned are based on anecdotal evidence and did not provide us with a framework for determining a natural progression in teamwork behaviour for groups.

Therefore, the paper will aim to identify and discuss what kind of issues and challenges student groups experience during the first semester of their university education, and measure the quality of the group work by analysing the Process Analyses of student groups from three engineering, science, and mathematics programmes. The paper will apply the theories of Katzenberg and Smith (1993) concerning high performance teams.

2   Five stages of team performance and their characteristics

For team members and teams – as well as for supervisors – recognising when a team is doing well is important, especially since the workings of a real team, let alone a high performance team, are not always obvious or intuitive to everyone. Katzenbach and Smith (1993) identify five different types of teams of which the first two are not really teams, but either a group of individual people collaborating on a shared issue or
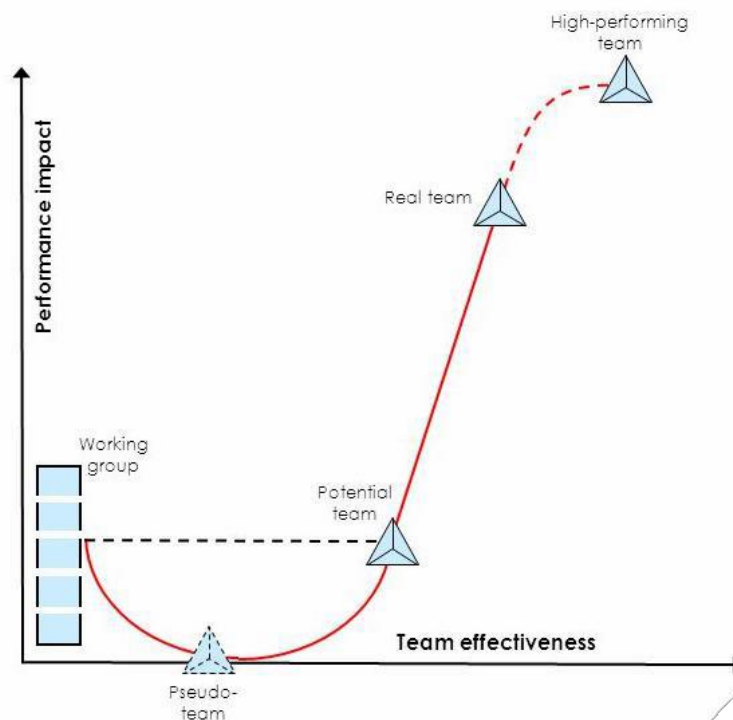

Figure 1: Five stages of team performance (Katzenbach and Smith 1993).

a group of individual people, who speak and act as if they are committed to the same goals without being truly united on the performance goals (see Figure 1). The third kind of team is a potential team, which is a group of individual people who are on the cusp of having a common purpose and goal. They also recognise the need for collective activities and achievements, and acknowledge and accept the collective need for mutual accountability, conflict resolution, and negotiation from a shared point of view. That is, they are following the conviction "we are all in this together".

Only the last two categories – real teams and high performance teams – can be identified as actual teams from an effectiveness and performance point of view. Katzenbach and Smith (1993) identify 5 + 2 characteristics that identify real and high performance teams: (1) Real teams have a common purpose and goal; (2) apply collective activities; (3) produce collective products; (4) hold each other mutually accountable; and (5) dare to go into conflicts. High performance teams, in addition, also have (1) an *explicit* focus on continuous learning and (2) mutual trust and respect.

In the following sections, we will go into details with the different types of teams as described by Katzenbach and Smith (1993), while also referring to some of the tools and management perspectives we teach in the related PBL course.

2.1 The working group: No performance need, no common purpose, and an individualistic approach

The working group is characterised by a lack of performance need that would otherwise require it to become a team. The members work together as individual entities with individual purposes and goals, primarily interacting to share information, align tasks, and support the performance of each individual within a designated area of responsibility (Katzenbach and Smith 1993, p. 91). A working group will typically consider a project work as something that can be divided into different sub-tasks and handed out to specific individuals. Each individual is then expected to know how to deal with the matter at hand and is held independently accountable for the production of specific deliveries. Conflicting issues are avoided, neglected, handled by rules, control, or pseudo consensus (Bøgelund 2014). Knowledge sharing and learning is implicit and not a goal in itself.

2.2 The pseudo team: A performance need paired with the lack of common purpose or goals

The pseudo team is characterised by the presence of a performance need, which would call for teamwork, but the team is unable or unwilling to gather around a common purpose and performance goal. In terms of performance, the team is worse off than the working group. There is not even an individual purpose or goal to adhere by and there is certainly no joint benefit (Katzenbach and Smith 1993, p. 91). Pseudo teams lack the skills or the motivation to find common ground, to set a course, and to muster the effort to follow it. Conflicting issues are mostly ignored, avoided, neglected, or dealt with in a half-hearted manner. Pseudo teams are teams who avoid taking risks regarding conflicts, joint work-products, collective action, or the pursuit of common goals. Working on motivation and acquisition of basic skills – be it problem solving, interpersonal, technical, or functional – is of importance.

2.3 The potential team: Acknowledging the risks – taking the first steps towards team work

Similar to the pseudo team, the potential team is characterised by the presence of a performance need. The potential team, however, sets out to rise to the occasion and therefore acknowledge and accept that becoming a team involves risk taking and efforts to invest in the course, in each other, and in the development of skills. Potential teams seek to establish a common purpose and goals without much success. As Katzenbach and Smith (1993, p. 91) puts it, the potential team typically "requires more clarity about

purpose, goals, or work-products and more discipline in hammering out a common working approach" and "has not yet established collective accountability".

2.4 Real teams: Common purpose, performance goals and approach; accountability and courage

Real teams "are equally committed to a common purpose, goals and working approach for which they hold themselves mutually accountable" (Katzenbach and Smith 1993, p. 92). Even when people are working on different aspects of a project, effective teams understand the end goal. They understand the purpose. Habit 2 of Stephen Covey's *The 7 Habits of Highly Effective People* is "Begin with the End in Mind". Covey was writing about making powerful changes for personal leadership, but the principle is still relevant to a team (Covey 2005). Making a team consider questions like, "What are we creating?" and "How do we want to make a positive contribution to our team and to our education?" can have a profound effect.

In the face of a performance need, real teams apply collective activities and produce collective products. They share knowledge and hold each other accountable – when they discuss, when they plan and when they carry out the plans. When they disagree, they dare to enter the conflicts. Real teams debate and the debate is an invaluable exercise to flesh out ideas, concepts, and strategies; debating, challenging, and defending ideas results in better ideas. It may feel uncomfortable to argue, but that is why it is so important to create a safe and trusting environment.

2.5 High Performance Teams: Mutual trust and respect along with a focus on explicit learning

Over time, a real team has the opportunity of becoming a high performance team. A defining characteristic of this team is mutual trust and respect. High performance teams operate in an environment where they have each other's backs; members are deeply committed to one another's personal growth and success. High performance teams seek to learn and improve at all times both to reach their common goals and to let individual members strive and prosper. For the common good, the team takes risks, shares successes and praise, and is quick to reveal missteps. This is important because highlighting mistakes at an early stage makes them much easier to fix, while the team is learning relatively more at a faster pace. Operating in a trust-filled environment breaks down barriers and allows people to be more vulnerable.

Ultimately, high performance teams come to work in a communal culture. This is when team members are not worried about who gets the credit, and they go out of their way to serve each other. When a team has a communal culture, it is not about the individual team member, it is primarily about the team exerting ownership of the work while supporting each other, because they want both the team and the individuals to be successful.

3   Case: Process Analyses at Aalborg University

Methodologically speaking we examine Process Analyses from three different clusters of programmes taught in the 5 ECTS PBL course during the first semester of 2016. This course is taught by different teachers and the students are clustered in different cohorts of somewhat similar programmes, usually having around 100-200 students. The three programmes analysed were from three different cohorts taught by each of the authors. That means the PBL courses had similar learning objectives, but the exact teaching and learning activities varied. Specifically, we selected 13 Process Analyses from the Mathematics programmes, eight from Mechanical Engineering, and eight from the Chemistry Technology programme. We performed documentary analysis of these Process Analyses both bottom up and top down, applying the framework of Katzenbach and Smith (1993). While we used the framework of Katzenbach and Smith (1993), acknowledging it as a

recognised framework used to describe effective teams, we also need to acknowledge that the framework belongs to the world of business life. Consequently, it might need to be adjusted to adequately describe teamwork in a university setting. Therefore, we cannot apply it without, at the same time, reinterpreting it for a university framework. In practice, we therefore analysed the Process Analyses by first exploring and identifying statements describing issues and challenges the students experienced as well as statements reflecting efficient and effective performance. These statements were then compared to the framework of Katzenbach and Smith (1993) to search for best fit – a comparison that generated discussions on how to distinguish between the types of groups, hence triangulating our approach (Titscher et al. 2000). This also facilitated a more detailed description of the stages of performance by Katzenbach and Smith (1993). As seen below, the process led to a more detailed description of, for instance, what it means to have a common purpose even when group members are very different; e.g. Is this difference something the students learn to cope with or is it something they cherish?

4   Findings

A Process Analysis from Mechanical Engineering was deselected due to insufficient content to make assessment of any team stage. From the remaining 28 groups, two were labelled pseudo teams, 16 groups were potential teams, nine groups could be labelled as real teams, and two groups were high performance teams at the time when the first semester finished (see Table 1). Each team developed during the project period as some teams might have started out in an earlier category to end up in the next one, or the next one again. The real teams and high performance teams obviously did not pass through the pseudo-team stage but developed directly from a potential team. In general, we did not find patterns of programmes only consisting of certain teams and not others. It would furthermore have required many more groups in each programme to determine such a pattern in any statistical way.

	Pseudo team	Potential team	Real team	High Performance team
Mathematics	0	9	4	0
Mechanical Engineering	2	2	2	1
Chemistry Technology	0	5	2	1
Total	2	16	8	2

Table 1: Overview of categories of groups in the three programmes.

In the following sections, we will go into detail about how the theory of Katzenbach and Smith (1993) is played out in a university setting. What kind of strengths and challenges do we find in each category? We exemplify each category with some quotes from the Process Analyses, translated from Danish by the authors. The brackets indicate the programme as well as the group number.

4.1   Pseudo teams' characteristics

Overall, according to the theory, pseudo-teams are struggling to find a common ground and the motivation or the skills to pursue unified goals in an effective and efficient manner. They have very little performance impact. This is certainly true of the two groups characterised as pseudo teams, both found in the Mechanical Engineering programme. Taking the two pseudo teams together, the challenges outweigh the achievements throughout much of the project-period. However, towards the end, the teams managed to define and handle

tasks and issues to deliver the required project report. Having been unable to establish and adhere to common and transparent values and norms, the groups' work efficiency and effectiveness is generally low prior to the status-seminar, and in combination with a fragmented structure (project and time-wise), the individual efforts do not overcome the many discrepancies nor make up for increasing uncertainties:

> The reason it went a little awry from the beginning was that even though someone tried to take initiative to take the lead, it was not respected by the other group members since the group often quickly lost focus. This, combined with the fact that the group had difficulty reaching an agreement about the direction of the project, was an inefficient combination. Our work was very marked by us all having very different ways of how we wanted to work (ME B206).

Despite regular meetings with supervisors, the pseudo-teams struggled with keeping an overview of the project, academic standards, sharing information, seeing things through, and following a strict line of focus – and accepting these struggles as part of the learning trajectory. Collaboratively, they found it challenging to manage time and deal with diversity. People opted out. Seldom was the full team present and the tone could be harsh or too frivolous.

> The fact that people came late all the time meant that it was difficult for the rest of the group to make sound and lasting decisions. The reason was that there were only a few people behind the decisions, and the decisions were therefore changed. It also made it hard to start a day's work since there never was a real starting point for the day and it was therefore not possible to plan the day efficiently (ME B207).

As mentioned above, the two pseudo-teams did complete a project report, ultimately because of deliberately diminishing distractions and irrelevant activities, reaching consensus on needed goals and tasks, and accepting distributed leadership-roles guiding and helping team members. Both teams attached great importance to the application of short-term planning and management (visualised on boards) during the last few weeks, however, collective accountability and risk taking appears to have been avoided.

4.2   Potential teams' characteristics

As stated above, the potential team is characterised by the presence of a performance need and they accept that becoming a team involves risk taking and trust in each other. For the university students, we notice that some groups are characterised by having a variety of challenges, which first are left unsolved, but after some developments the groups change their behaviour and succeed. Partly, this is a consequence of groups developing a clearer purpose as well as developing their mutual and collective accountability. Some groups learned through the semester that they needed to distribute the responsibility of different tasks to different group members; not everybody could do all things. They learnt that they needed to develop mutual trust in each other. Other groups in this category learnt that when they had distributed the responsibility of different tasks, they could also successfully use each other as sparring partners to discuss issues. Some groups stated that the status seminar halfway through the semester was a real wake-up call.

Some quotes from the Process Analyses illustrate this:

> In the beginning, the project had many loose ends. In relation to the tasks, the lack of overview, the group work was sloppy and it was actually very

> demotivating not to know how far we were and all the loose ends we had which seemed impossible to gather. Some days seemed like there was no contribution to the project. But after the introduction of the scrum board, the work morale increased, and you could see how the work moved forward and you realized what was done and what it took to finish the project … It really increased the work morale to implement a project management tool that worked for us (ME B209).

Another group:

> The collaboration was very individualized as the group members often sat alone and worked on specific topics … This was something that in the previous project's Process Analysis had been taken note of, and it had then been concluded that it might be a good idea to make people work more together on a topic. Especially if there was one who had more knowledge of a topic, then it could be good to put them together with others who at this topic knew less. Otherwise the whole idea of group work disappears and then the group might just as well sit at home and once in a while write to each other. When everybody was working in the group room, it was also possible to discuss individual tasks, which often happened. Usually this led to good scientific discussions, when one did not get side-tracked (ME B208).

A group also argued that, after some difficulties in the beginning of the project work, they began to help each other and be considerate of each other's learning styles (the PBL course had included the topic of learning styles). They then concluded in their Process Analysis: "In this way we experienced that jointly we were able to achieve the best product" (Math A218a). Another group stated something similar: "The group showed understanding for the fact that they were different so no one felt under pressure to work in a certain way" (Math A213). However, the group did not go into any details about to what extent it was an advantage that the members were allowed to work in own way or that the differences were an advantage. Nevertheless, they show that they could manage the different types of people. One group wrote: "The group members complemented each other well and when one stops another is ready to take over" (Math A217b). Another group stated that they at some point realised that the members had different levels of ability, "We have chosen to perceive this as something positive since our different ability levels can help us cover for each other's weaknesses" (Math A221a).

What we see here are groups that are having their first experiences with the realisation that being different is not necessarily harmful or wrong but can be turned into an advantage. They are making the first steps towards becoming a real team.

4.3   Real teams' characteristics

Real teams are characterised by participants all being committed to a common purpose to which they hold each other accountable. They think of themselves in terms of "we" and perceive the product as a collective product. They appreciate that they are different and they dare to enter into conflicts.

For instance, we found groups who stated that when they realised they were on a wrong track or stuck, or conflict began emerging, they discussed it and moved forward. We also identified groups that used communication in frequent meetings for knowledge sharing and they found it beneficial that group members

revised each other's sections in the report: "Furthermore the group members revised each other's written parts of the report and in this way the sections were improved and each group member got updated on what the others had worked on and which parts were finished" (ME B205).

We also found groups that directly stated they perceived that being different was an advantage. One group stated: "For this reason, the different learning styles actually complemented each other and the group was rarely caught for too long in the same track" (Math A214). Other groups were also very proactive in conflict management and worked towards preventing that conflicts should even emerge, which is illustrated by the following quote: "The group has had huge focus on making the collaboration work at an optimal level by preventing possible conflicts and solve them as quickly as possible" (Math A217a). This is stated by a group who also writes that they sometimes have problems with members not being on time, being unprepared, and unequal distribution of workload. This group consisted of eight students, of which three were studying other topics alongside the mathematics project. Two other groups directly state that: "The fact that we were different has meant that we in the group have complemented each other well during the writing process" (Math A220a) and "We have taken advantage of our different competencies. So we supplemented each other to achieve the best result" (Math A221b).

Other groups stated that despite challenges with time management, the direction of the project, and some people being late, they were good at sharing knowledge and solving problems. They stated that they had a common spirit, helped each other, and distributed work.

There were also some groups that found themselves to be a high performance team, writing, "as we were gathered towards a common purpose, had the same ambition for the project and a common approach to the final product … help each other in all ways and not just in the project work" (ChemTech B343). This group was also good distributing work, ongoing planning, revision, discussion, and knowledge sharing. However, they still had challenges with proper preparation for meeting with supervisors and clarity of mutual expectations. Consequently, they were not yet perceived as a high performance team, but certainly on the track to becoming one.

4.4   High performance teams' characteristics

High performance teams seek to learn and improve at all times both to reach their common goals, but also to let individual members strive and prosper – for the common good: the team takes risks, share successes and praise, and is quick to reveal missteps. One group explained it this way:

> The reason why the group actively chose to apply the tools from the course
> was to ensure gaining the optimal from the project and the process. It was
> here the group could test which tools worked best for them, as well as force
> them to use other arguments than "common sense" and hereby ensure that
> new learning took place in the group (ME B203).

Here we saw that the group was willing to take risks applying different tools and reflecting upon them to prosper. Among the evidence in support of characterising the two groups as high performance are deliberate efforts of ongoing monitoring and improvements backed by systematic approaches to apply methods and tools. Uncertainties and challenges were acknowledged, prioritised, and dealt with daily throughout the project period. The groups prioritised discussion over voting by majority ruling. Activities and role-functions were coordinated as consequence of responsibility and ownership – based on shared intentions to apply tools offered, avoid misunderstandings, and wasted resources while learning as much as

possible. These groups proved that foresight, awareness, and attention to detail pays off. Apparently, nothing had been left to chance.

The Process Analyses document how the two groups' ongoing reflections incorporate more aspects of project-work (including how course-work interacts with project-work), thus testifying how transparency fosters efficiency and effectiveness. We also saw they had a well-structured knowledge sharing and time planning. Although the groups have succeeded, they still point to areas of potential improvements that will allow them to fulfil the increased requirements of the following projects.

5   Discussion of findings

5.1   What types of groups were found

Two groups proved to be pseudo teams, 16 proved to be potential teams, nine could be labelled as real teams, and two as high performance teams by the end of the first semester. As seen above, it was possible to apply the different concepts to each group. However, a question that arose during the analysis was: If a group experienced problems, was that an indicator that the group was not a Real Team? We argue that all groups will experience problems but what distinguishes the groups from each other is how soon they solve the problem, how they solve it, how well they solve it, how they reflect upon the causes and cures – and, to some extent, the types of problems experienced. This means that groups experiencing repeated problems of members being late (as well as several other problems) are at a lower stage than groups where lateness was a minor issue and something that was settled early in the semester.

Although the two pseudo teams did perform at the very end – supposedly as a result of pressure for performance and an emerging critical mass of knowledge – we argue they did not develop into potential teams. Their Process Analyses avoided identifying root causes and factors and only vaguely pointed to future improvements (ME207). What is more, the Process Analysis documents showed a consistent lack of social integration as well as a lack of collective trust and accountability (ME206).

The feedback and feedforward provided during the status-seminar (normally halfway through the project-period) appears to function as wake-up call for the lower level teams. Suggestions and impressions from other groups led to immediate initiatives to improve procedures, resulting in increased efficiency and effectiveness.

Some groups were able to *handle* differences while seemingly still being annoyed by those differences while others saw the differences as an *advantage*. We argue this is something that distinguishes Potential Teams from Real Teams. Another thing that distinguishes these two is whether the groups dare enter into conflict, i.e. addressing the problems upfront and not steering away from the problem. Other important factors characterising a group as being a Real Team is common values and ambitions, a common strategy, a good structure for planning, deciding on team roles, and demonstrating the ability to share and coordinate knowledge. However, we also needed to judge and balance different comments written in the Process Analyses since different comments might point in different directions.

Considering these were first semester students, it is remarkable that two groups can be characterised as high performance teams, which is a very advanced stage. The seven students in the group from the Mechanical Engineering programme originated from four of the initial groups in the pilot-project during the first month of studies. This verifies the common practice of students to identify, negotiate, and select preferred group members prior to official group formation. In the Chemistry Technology programme, the students could also

change groups at this point, but they usually remained in the initial groups. All groups in all programmes were designed at random by the administration at the very beginning of the first semester, as the students did not know each other when they began their university studies. Furthermore, the students in Chemistry Technology were explicitly introduced to the theory of Katzenbach and Smith (1993), which might have had an impact on the groups' awareness and choices – including the reasoning used in the Process Analyses. The other students were also introduced to conflict management and types of groups, but with a different framework than the students in Chemistry Technology. One might form the hypothesis that the teacher's prioritisation of course activities can support the students in developing team function, but such conclusion is beyond the scope of this paper.

5.2   The usefulness of the theory of Katzenbach and Smith (1993)

The aim of the paper was to identify challenges the students meet when they start working in a PBL group during their first year of study. We have applied the theory of Katzenbach and Smith (1993). As seen above, the theory was suitable for describing the stages of the groups. However, the theory also has some limitations when applied to a university setting. One limitation is that at AAU we would not meet any working groups due to the pressure of performance stipulated in the study regulations of the programmes investigated: students *must* work in groups and submit a joint project report in which all students are accountable for everything in the report, even parts they did not produce themselves. Students beginning their university study might have had a perception of a "good" group as something that functions like a working group, but they would have to change this attitude and behaviour to fulfil all requirements of the study. Some students left the university during the first year. Some could not adjust to the organisational and social obligations, and some did not like working in large groups.

Since this study assesses the Process Analysis after the first half-year of study, one might anticipate that some students might still see the working group as an ideal, and thereby fail to recognise the importance of having "to take responsibility for results other than their own" (Katzenbach and Smith 1993, p. 89). As working group members tend to "pay attention to individual outcomes and results" (ibid.), such groups will be characterised by an individualist approach and dominance aiming for optimising individual performance in the exam.

One might also argue whether high performance team function is a realistic goal to set for the first year at university. Students are new to university study; do not know each other, and they usually select their own groups each semester. This is different from the settings in professional life, where people usually do not choose their colleagues and usually people in business life work together for a longer period than half a year. The student groups also had supervisors to assist them with both the content of the reports as well as process issues of collaboration. Often the idea is that the students should learn collaboration skills and project management while doing it in the groups. Staff rarely perceive a rather unsuccessful project-report during the first semester as a catastrophe, especially when the students are able to prove that they learnt from their failures – and naturally when having learnt sufficiently to pass. However, in business life, the setting is different.

5.3   Main challenges

The main issues and challenges reported in Section 4 -- Findings -- constitute a rather long list. However, the fundamental challenge for groups is to embrace the struggle of the process. Handling the challenges is often a matter of practicality: dividing problems into manageable tasks. A couple of higher order issues, such as performance and exam anxiety, coupled with the uncertainty of doing something for the very first time, must

therefore be made adequately transparent on a continuous basis. The observed effect of the "wake up call" resulting from the status-seminar is a fulfilment of the essential need for transparency at a point where a critical mass of technical knowledge is accumulated, coupled with sufficient certainty of what-not-to-do. This spurs agency within the group, enabling appropriate handling of prioritised challenges.

A yet unanswered question in this analysis concerns the individual students' personal values, preferences, and behaviours and how these influence the path towards embracing each challenge. The Process Analyses do not provide evidence for any conclusions in this respect. Our experience tells us, nevertheless, that personal issues are important and that such issues do have impact during all undergraduate semesters, although not for all students and not in all semesters.

5.4   Validity of the Process Analyses

The analysis is based on the Process Analyses that the groups were obliged to produce as supplement to the technical semester reports in the first year of study. This naturally gives rise to questions about validity of the claims made by the students. One might argue that they tried to show themselves as better than they really were in an effort to impress the examiners. Nevertheless, the students were informed that it was a requirement to report on what went well and what did not go so well, as well as show their ability to argue for choices made and for possible improvements. We argue that we can ascribe a sufficient level of trust into the statements the students make. It is also reflected in the observation that very few groups in fact turned out to be high performing teams. Had the groups anticipated that they would be rewarded grade wise for being characterised this way, we would have seen many more groups displaying ample evidence of such characteristics.

Another source of error that might be more problematic is the issue of groups not elaborating much on some items. For instance, if a group did not write anything about whether they found their mutual differences to be a benefit, can we then conclude that they did not consider their mutual differences to be beneficial? In other words, is absence of evidence the same as evidence of absence? In professions such as archaeology, this would be a false conclusion to draw. However, since the students were asked to formulate things that went well, we argue that if they were clearly aware it was an advantage to be different, and they wanted a high grade, they then would have explicitly formulated something about this in their Process Analysis. We argue that if they do not mention a certain issue, or only mention it in a brief comment, it is evidence that they did not findthis issue particularly important or they have not yet fully realised its importance.

Another issue for validity could be that we do not know to what extent all group members have taken active part in producing the Process Analysis. Writing the Process Analysis might for some groups be something that had been delegated to some of the group members who had extra time. Likewise, some (or all) of the other group members might not have assigned high priority into producing a Process Analysis adhering to the learning objectives, as they anticipated (rightly) that the report would carry the most weight at the exam. We cannot know this from reading the Process Analyses; however, the Process Analysis was due two days after the report was due, which meant that each group member ought to be able to participate at least in the final stages of the analysis and writing, and they all should expect to be asked questions about the Process Analysis during the project exam. One might also argue that when students write about their process looking back, things might look different in hindsight compared to how the groups perceived the situation when it happened. A more accurate description and analysis of their process could have been based on weekly process analyses or assessment, observations, and interviews with the students. However, even though this

in theory would have given us data of higher validity, it is unrealistic to imagine that students would have time to provide us with detailed data of such frequency and depth.

We therefore argue that even though the Process Analysis might not be equally representative of each single group member, it is still an adequate representation of what the group members – as a group – had agreed upon. However, as evidenced by the deselection of a group due to a very weak Process Analysis, some groups chose not to put sufficient effort into writing the document. Hence analysing the Process Analyses is one way of getting information. Here we get insight into how they perceive themselves and how they reason. To get a fuller picture of how the group performed as a group, one would also need to, for instance, observe groups, interview groups and individual members, interview supervisors, and compare individual grades, but such activities are beyond the scope of this paper.

A final note concerns the objectivity of the analyses performed by the authors. Each author has been responsible for analysing the Process Analyses from the programme taught. To calibrate our assessment to the four stages within the framework set by Katzenbach and Smith (1993), we have sampled two Process Analyses from each of the other two programmes. The calibrating discussion proved valuable for refining the detailed descriptions in Section 4 -- Findings -- as well as for broadening the scope of this discussion.

6   Conclusion

Overall, we were able to apply the theory of Katzenbach and Smith (1993) to categorise different types of groups. However, the theory is not based on nor developed with university students in mind, so some specifications were necessary. One example is that the concept of working group did not apply to this particular university. We had to discuss very precise concepts in relation to determining what category a group belonged to in a university setting. We also found that our initial expectations of which types of challenges students experienced were to some extent seen in the Process Analyses, but they became clearer in our analyses.

We have seen students not only struggle with certain types of problems in the groups, they also become good at a great number of things. Regardless of the level of the groups, it was clear that the groups had learnt considerably about working in a team during their first semester. In different ways, they are able to work on projects and able to handle a wide number of problems such as lateness, different learning styles, personalities, and time management. When groups embrace the struggle with these issues, they are able to minimise consequences or solve problems – some groups do better than others, as reflected in the stage of the group.

Aalborg University has a long tradition of PBL, but PBL will not work properly unless the students learn to perform efficiently and effectively in teams. We therefore argue that educational institutions cannot expect students to learn to work in groups without assistance. What we saw in the Process Analyses were frequent references to tools learnt in the PBL course during the first semester. Such tools can be presented to students in manifold ways, but one may, as a last comment, put forward the argument that some kind of course is needed to assist students; otherwise, it will be an excessively time-consuming struggle for them to find their way through the challenges they encounter as a group during project work.

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