MAXIMISING THE PERFORMANCE OF MULTI-DIVERSE DESIGN TEAMS

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ABSTRACT

In our Integrated Product Design master at the Delft faculty of Industrial Design Engineering we see a growing diversity in our student population. Besides a growing number of different nationalities there are also significant differences in prior education, competences, and socio-emotional aspects. Within the Advanced Embodiment Design (AED) course, students work in teams on a client-based design project for one full semester. In 2018-2019, 22 student-teams started out their endeavour, coached by eight coaches. Within the course an important learning objective we want to offer students is the opportunity to experience and perform in a successful team, acknowledge all students' input, and experience a successful result. During the process of embodiment design, the project teams come across several hurdles which challenges team performance and their project progress, and thereby influences the project results. To maximise the performance of student design-teams we have conducted two studies researching the challenges these teams come across over the course of the semester. One study was based on the coaches' experiences during the project (Flipsen & Persaud, 2016), and the other one on the students' individual reflections on the project (Flipsen, Persaud & Magyari, 2021). The challenges our students come across are analysed and relate to becoming a team, doing the project right, and finalising the project successfully. The results of both studies are used to develop a framework supporting coaches in maximising the performance of multi-diverse design teams. The framework is built around the Theory U (Scharmer 2016), a model describing how teams work with each other, following the right path to success (presencing) or off-tracking by muddling through, or by absencing. To track the different team's performances, we use a project-group tracking-system existing of seven Key Performance Indicators combined with a coach journal. The combination of KPI's help the team of coaches to pinpoint lower performing teams and intervene when needed. In this paper we will present the framework, consisting of (i) preparatory activities to initiate trust, teambuilding, and a successful student cooperation, (ii) a system to track the student-teams' health and performance and pinpoint troublesome groups, and (iii) responsive activities related to the hurdles teams might come across and how to reverse them. To assist the individual coach, we have developed several responsive activities the coach can use to intervene, slowing down the process of dysfunctionality and revert the process towards highly performing teams. The activities are tested in the two cohorts following our initial studies in 2018-2019.

KEYWORDS

Multi-diverse, teams, lessons learned, reflection, team dynamics. Standards: 6, 7, 8, 9, 10.

INTRODUCTION

In the master at Industrial Design Engineering (TU Delft) we see a growing diversity in students. In recent years, the number of international students has grown by more than one third of the cohort's population. We also see differences in prior education and competences, especially compared to our own bachelor's degree. In the master course Advanced Embodiment Design, more than 100 students work in teams on a client-based design project. The project starts out with a physical prototype at Technology Readiness Level 2 or 3 (TRL2-3) as defined by NASA in the 1970's (Mihaly, 2017). Within the time given the student team's goal is to engineer the product to a near-production ripe product embodiment at TRL 5 to 6.

The course runs over a full semester and, when successfully completed, is awarded with 21 European Credits (EC), which encompasses a workload of 588 hours per student. Every team consists of 5 to 6 students who are taught in five expertise area, each encompassing 10% of the student's workload. The knowledge acquired in the expertise areas must be applied in the *Project Embodiment Design (PED)*, which encompasses 50% of the student's workload. The expertise areas are diverse and include the following variety of subjects (figure 1):

1. *Advanced Design Enablers (ADE)*, where students learn about systems engineering and design (Bonnemat et al, 2016), dissecting a product in components and optimize for part and system functionality using finite-element analysis and rapid prototyping techniques.
2. *Advanced Ergonomics Feasibility (AEF)*, where students learn and apply physical and cognitive ergonomics, making a product more usable.
3. *Product Experience (PE)*, where students learn about user-product interactions that lead to pleasurable product experiences such as aesthetics, meaning attribution and emotional responses (Desmet & Hekkert, 2007).
4. *Sustainable Design Engineering (SDE),* where students will analyse the project on the triple bottom line, people, planet, and profit using the sustainable development method developed by Ashby (2016).
5. *Smart Systems & Technologies (SST),* where students are introduced IoT systems and tools and methods around electronics, data collection, data analytics, and machine learning to support the design of smart product-service systems.
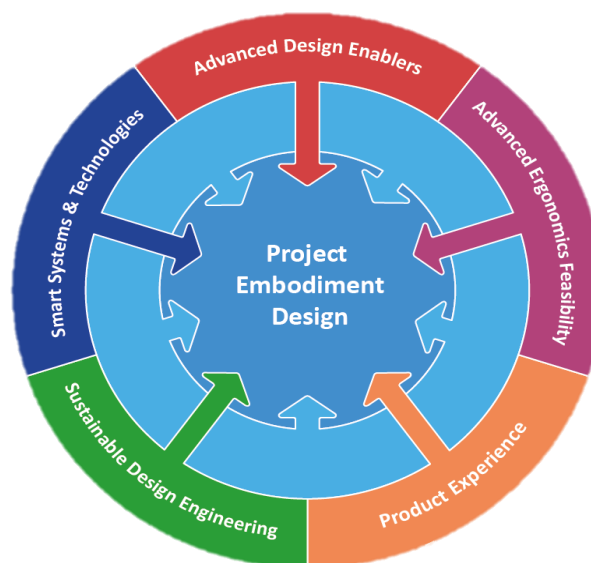

Figure 1. Five expertise areas giving direction to the Project Embodiment Design.

Workflow

During the first 3 months of the course students will focus mainly on the five expertise areas and partially on the project. Activities related to the project consist of getting started within the team, setting up a planning and communication protocol, analysing the product system's architecture, and defining the main challenges of the product-system. During the mid-term presentation the student teams are up-and-running and will present their main challenges which they will tackle during the second part of the semester.

Diversity in teams

In an ideal world the student teams will get into flow fast and finish the course successfully without issues, but in most cases, discord is already happening during the first weeks of the course, the team-building phase. The student teams either consists of a group of friends who want to work together on a project, or the team is put together based on their project preference. 50% of the students are bachelor students from the TU Delft doing their master at IDE, and 50% have been schooled at other universities globally. 1/3rd of all students are foreign students coming from all over the world. The diversity within the team due to differences in nationalities, prior education and design approaches, emotional differences, and in skills and competences, can and will lead to confronting situations within the teams when working for such a long time together on a project (Flipsen, Persaud & Magyari, 2021). Examples of hurdles teams must overcome are communication confusion, frustration, and sometimes interpersonal collisions (Flipsen & Persaud, 2020). There is a growing gap between the team members on cognitive and socio-emotional aspects and their ability to deal with this constructively. We also noticed that for the team of coaches it became more difficult to coach these increasingly more diverse student groups because of a lack of knowledge in dealing with it.

Coaching multi-diverse teams

The final deliverable for a team consists of an embodied design of a product. However, the major learning is not in designing the product, but in working together and inclusively in the design-team. The experience of differences between team members and learning to trust each other is the basis of a functional team (Lencioni, 2002). To support our students in a safe way during this process, we need to professionalize our coach team and focus more on team dynamics, getting in flow with the project team, and experiencing a higher level of collaboration.

This paper will present our approach in maximizing the performance of multi-diverse teams using (i) preparatory activities to initiate trust, team building, and a successful student cooperation, (ii) a system to track the student-teams' health and performance and pinpoint troublesome groups, and (iii) responsive activities related to the hurdles teams might come across and how to reverse them. The preparatory activities consist of getting to know each other on a deeper level and build trust among the team members. The Theory-U (Scharmer, 2016) is used as basis for guiding teams in the right direction of presencing. The experience of "wandering of the right path" (either by muddling through or by absencing) is not something we don't want our students to experience, but when it happens, we want the team to reverse this process and return to the presencing field as soon as possible. To reverse this process, we propose several techniques to get to real solutions for teams to work together in a professional fashion. Reflection (Schon, 1991) and dialogue (Isaacs, 1999; Cooperrider & Whitney, 2005) are techniques used in this process.

In the next section we will explain the coach framework, where we use *Theory U* as the basis for good teamwork, and how *dialogue* is used to improve team communication. To pinpoint off-tracking teams, we have developed a *Performance Dashboard* to track the team-performance while running the project. When teams are off tracking, we have developed several exercises to reverse that process. Both the tracking system and the techniques used to reverse the

process of muddling through or abscencing, are discussed in the follow-up sections. We will conclude this paper by reflecting on our learnings when applied in the latest runs of the course.

COACH FRAMEWORK

Theory-U as basis for good teamwork

The context and reality of the AED project is important to understand. The traditional context of teamwork as described by Tuckman and Jensen (1977) and Smulders et al. (2012) is a hierarchical step by step approach of Forming, Storming, Norming, Performing and Adjourning. Although Smulders does address student teams, he does not consider the diversity and iterative developmental nature of the AED student teams. Miller (2003) and Senge et al. (2004) views on teams are more related to the AED context. Groups are developmental dynamic social systems with personal and group related processes of creativity, introspection, and intuition. Many of the design challenges far exceed the knowledge and skill that any one student can possess and therefor teamwork and collaboration are very important.

Theory U is a model developed by Scharmer (2016) that applies well to AED teams. "It transfers easily from an individual to a collective context and holds great potential to spark the learning that is necessary to improve team functioning and enable greater performance" (Hays, 2016). It also applies well to the AED design process, where the 20 weeks duration provides a long enough timespan for the U processes to take place.
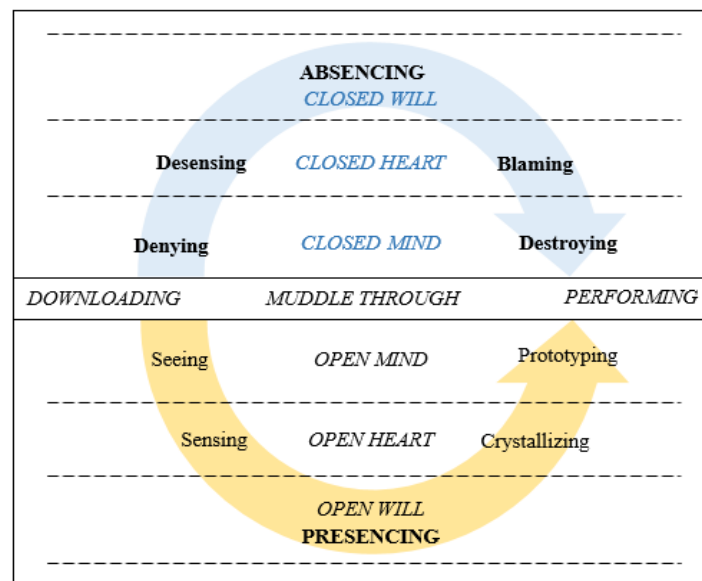

Figure 2. Theory U, adapted from Scharmer (2016).

Theory U describes two opposing processes of presencing and absencing. Presencing is a process of collaboration and embracing emerging possibilities, where absencing is a process of disconnection and getting stuck in old habits. Scharmer also identifies a process of muddling through, where teams are in between presencing and absencing.

As figure 2 shows, both pathways contain five phases built upon three elements of communication the mind, the heart and the will. Each team starts from the stage of "downloading", where students get together and engage based on past patterns. The first phase teams go through is communication from the 'mind'. It is described as non-judgmental (seeing), or judgemental (denying) communication of team members based on prior

experiences. The second phase is where teams develop communication from the 'heart'. It is about the emotional connection (sensing) or disconnection (desensing) of team members. The third phase is when teams communicate from the 'will' or the ability (presencing) or disability (absencing) of a team to act in an instant. When following the pathway of presencing, the following phases are crystallizing (open heart) and prototyping (open mind). When following the pathway of absencing, the following phases are blaming (closed heart) and destroying (closed mind). In the dynamics of the design project, the student teams will develop towards one of three pathways: presencing, absencing or they muddle through.

Dialogue as basis for team communication

Within Theory U, communication within the team is central in the team process. Scharmer (2016) describes four types of conversations:

(i)   *Talking nice*, confirming the positive aspects, the goodwill, filtering, politeness, and self-censoring.
(ii)   *Talking tough*, responding to counter others' arguments, such as debate, discussion, and conflict.
(iii) *Reflective dialogue*, understanding and accepting the others perspective without feeling the need to disagree with them and allowing diversity of perspectives.
(iv)   *Generative dialogue*, focussing on the human experience of the other and what resonates with their own humanity, sensing the wholeness of which we are part, unity in diversity.

Talking nice and talking tough is prominent in the absencing process and reflective dialogue and generative dialogue are applied in the presencing process.
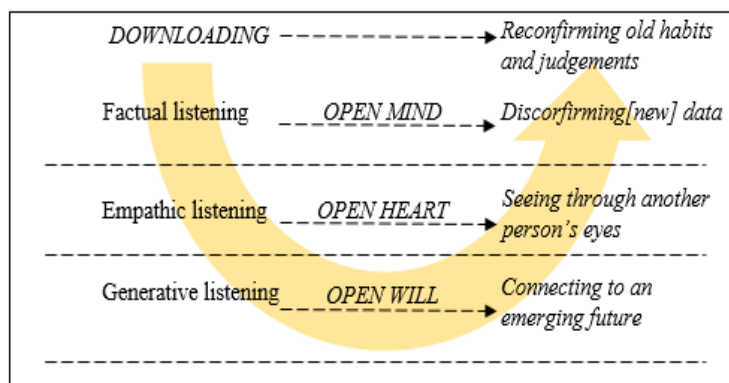

Figure 3. Four types of listening adapted from Scharmer (2016).

Within these fields of conversations, Scharmer (2016) also describes four types of listening corresponding to the phases of the presencing process. These types of listening support teams for moving through the u process and transferring "Reflective Dialogue" to "Generative Dialogue" (figure 3):

(i)   Downloading: listening from habits of judgement.
(ii)   Factual listening: listening from outside and noticing differences, listening with an 'open mind'.
(iii) Empathic listening: listening from within, sensing, listening with an 'open heart'.
(iv)   Generative listening: listening from source, from what is emerging, listening with an 'open will'. This communication approach can shift the teams to see and use the differences as an asset instead of a hinderance.

TRACKING TEAM PERFORMANCE

Performance Dashboard

To implement a quick and easy overview of the performance of our student teams we started out with a project-team tracking system, which kept track of the performance and the healthiness of the student team on a regular basis. We used Google forms to aggregate data in a weekly coach journal. Every week all our coaches entered their journal in the sheets which on its turn was used as input for our weekly meeting. The performance is tracked by means of 6 key performance indicators (Marr, 2012), and a textual journal consisting of problems within the team, project progress and other stuff. We differentiated between strategic KPI's, which monitors the progress of the student team in relation to the end goal, and operational KPI's, which monitors the team dynamics. Strategic KPI's consist of progress of defining (i) the key challenges, (ii) the research questions, and (iii) the method of approach. The operational KPI's consist of (iv) project management, (v) planning and on-time completion, (vi) group dynamics, and (vii) perceived stress levels (Flipsen & Persaud, 2020).
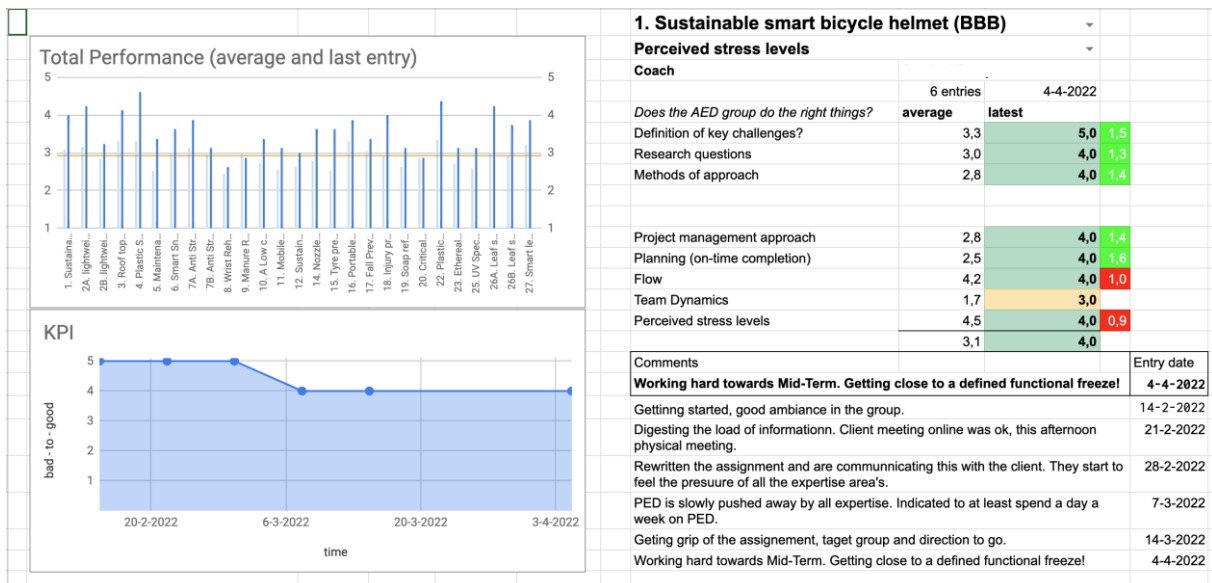

Figure 4. An example of the Performance Dashboard used to track student team's performance.

To present the data in a quick and handy format we produced a performance dashboard using Google Sheets (figure 4). This gave us a quick insight in the performance of the different groups relative to each other, see top left bar chart. With the historical average (light blue) and the current team performance (dark blue) we can pinpoint the low and high performing teams and discuss them using the project-specific data, see top right. Besides the team's name and coach this data consists of average historical performance per KPI, the latest update and the positive (green) or negative (red) changes in performance over time. In the example, for instance, it shows that team 1 has improved on all aspects but for the "flow" and "Perceived stress levels" where the performance dropped with 1.0 and 0.9 point. Besides the quantitative KPI's the dashboard also shows the coaches' journal about the team (down right). This journal is used to pinpoint the exact problems with this group, fire-up the discussion within the coach team and come to solutions on dealing with them. With this tracking system we quickly pinpoint troublesome groups, eg. team 8 is underperforming in this phase of the project. The comparison and insights from the dashboard are used to lead our discussions during our weekly coach meetings. Instead of discussing all student groups individually we herewith can

focus on problematic groups and come to solutions which are implemented immediately. Solutions are found within the diverse knowledge fields from within our own team of coaches or were introduced by external experts. Issues concerning, amongst others, multi-cultural differences and socio-emotional aspects are in this way effectively tackled without loss of time and is discussed thoroughly in one of our earlier papers (Persaud et al., 2021).

The tracking system helps in classifying teams to one of possible responses within a team (Schamer, 2016): muddling through (denial), moving apart (absencing) or moving together (presencing).

Reflection

Besides coaches reflect on student-team's performance, we promote self-tracking of the team and team members to become a professional reflective designer. Students are introduced to Reflective Practioner (Schon, 1991) and different reflection methods (Gordijn et al., 2018) during the course, reflect as a team during the mid-term and individually at the end of the course.

REVERSE OFF-TRACKING

Based on previous research (Flipsen & Persaud, 2020) we identified the key issues which made student teams move from presencing towards muddle through or abscencing. We have identified four types of diversity consisting of differences in: (i) cultures, (ii) design approaches, (iii) socio-emotional background, and (iv) competencies. To address these four differences affecting team dynamics several methods have been collected to help the coaches in addressing them.

Preparatory

At the beginning of the project, we use several startup exercises to get a jump start in the downloading phase and getting used to communication through (generative) dialogue. The following exercises have been used in the past course runs:

- *Who are you:* In this exercise both students and their semester coach make a poster to present themselves. They visualize and textualize answers to questions, to show their personalia, personal values, needs, strengths, etc.
- *Best meal ever:* Students talk to each other about their favorite dish. They support the person who is talking by asking questions about the content, situation, preparation etc. It is an exercise to learn about listening, talking and supporting.
- *Roses and thorns:* Each meeting students start with a check-in round. They share what is on their mind before they start with the design project content. Roses are about personal nice things that recently happened, and thorns are about the things that are bothering now. It is an exercise for empathic listening, sharing and reconnecting.

Intervention exercises

Using the performance dashboard, we discuss the most troublesome teams in the cohort. The coaches share their experiences of discussion, debate and conflict within the student teams. These are signals of "talking tough" and indicate muddling through or absencing. Signals could be voices of judgement, cynicism, or fear which manifests themselves as quick judgement without questions, making fun of others, blaming, punishment, lying, or not showing up. Coaches then share thoughts about which key issues could be most relevant and use specific exercises to support the team to open and move towards the presencing pathway.

The following exercises have been used in the past course runs to get teams up and running again. The exercises are based on dialogue (Isaacs, 1999) and appreciative inquiry (Cooperrider & Whitney, 2005):

- *Design approaches and competencies:* When students are judgmental on the quality of work or debate approaches and design strategies, the *"Belonging, Being, and Becoming"* exercise is helpful. Students make a poster-visualization and address three elements of themselves. Belonging: where are you from, and to whom, where, and what are you connected? Being: what design-engineering or other skills and knowledge do you have now? Becoming: where are you going, where do you want to be, what do you want to know, what do you want to be able to do after AED? They must collaborate with someone from the team, who will present the others' poster and the team can ask questions.
- *Socio-emotional differences*: When coaches notice that students are self-censoring, cynical towards each other or blaming others we have two exercises for support based on sharing personal histories. "*Cool elementary school"* is an exercise where students share the nicest moment or experience from their elementary school. Other team members ask clarifying questions and listen to their stories. "*Mother and Father"* is another exercise where two students talk about their parents. One student talk, and the others listen and ask questions, after which they share each other's stories to the rest of the team (think-pair-share).
- *Cultural differences:* When a coach notices students have a cultural bias, the exercise of "*Team Culture Mapping"* (Meyer, 2014) is used. The method defines eight areas where cultures vary along a spectrum between two opposing extremes. It provides a framework for teams that face cultural differences. Team members analyse the position of their culture relative to one another. This enables them to decode how culture influences their collaboration. The space in between the extremes can be considered as a continuum. Within the range of behaviours of a given culture, individual differences occur. The goal of using the model is to support interacting between team members and improve watching more, listening more, and speaking less.

REFLECTIONS AND CONCLUSIONS

We believe that well-functioning teams will work towards high-quality results. Dysfunctional student teams will struggle through and fail the learning objectives of the course, but also loose trust in team performance. By pinpointing and act on issues as early as possible in the team process, all student teams experience a successful project and learn from the hurdles they come across. The last couple of cohorts, we notice that student teams are more in flow and that concerns on team dynamics are pinpointed and addressed at an earlier stage in the course. The use of the previously discussed exercises using dialogue and reflection are fruitful in preventing escalation and developing an open attitude of all team members. Even troublesome teams are managed to work in a professional manner, even thought they might never become friends.

Student teams will become better when their coach is also functioning on a higher level. Within the team of coaches, we also noticed biases due to diversity of team members, and difficulties in conversating. To become better coaches, we needed a base of trust within the team, where all members can be vulnerable, and open to each other. We therefore had to learn to move towards presencing and must become aware of each other's (in)capabilities and unconscious bias. In previous papers we have discussed the coaches' and students' perspectives on hurdles within multi-diverse teams. With these insights we have professionalized our coach team to cope better with issues in student teams. We have aggregated and developed several

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exercises to empower coaches in doing their work and being confident about it. Within the coach team we discuss possible exercises and how well they fit with the coach in question. Discussing and involving all members of the coach team in this process grows trust within our team, which constitutes to a learning environment where not-knowing and failures are accepted. We monitor each other's work, learn, and adjust without prejudice.

Given the high grades and international prices different student teams have won, we don't see an inflation in the results of the student teams. We therefor believe this approach is successful but need to be aware of the possibility for losing focus on content-related learning objectives. We therefor mainly work with design professionals who are parttime self-employed or work in a design agency. To keep the standard high, we are also mindful about course evaluations and student's reflections to improve the course continuously.

Every year part of the coach team is renewed, where team members leave, and new coaches are introduced. Coaching on team performance is different from the existing coaching on results, which requires extra attention during onboarding of new coaches. We therefor are working on educational materials which help coaches in becoming more confident and professional working with multi-diverse student teams.

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BIOGRAPHICAL INFORMATION

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Stefan Persaud: is senior lecture at the Delft University of Technology, focussing on pedagogy and didactics. Stefan is lecturer of the year 2021. He is teaching engineering courses, and has expertise in dialogue, diversity and inclusivity, and Theory U. He is part of the teaching academy panel of the Delft University of Technology to improve teaching capabilities of his peers.

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