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Mapping Master Students' Processes of Problem Solving and Learning in Groups in Sustainability Education

Anette Oxenswärdh * and Ulrika Persson-Fischier

Department of Civil and Industrial Engineering, Uppsala University, 752 36 Uppsala, Sweden; ulrika.persson-fischier@angstrom.uu.se

* Correspondence: anette.oxenswardh@angstrom.uu.se

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Abstract: Sustainability challenges in tourism are widely discussed. There is a huge need for education in the field of destination development. Students require appropriate problem-solving skills. This article examines the master's course in destination development at Uppsala University, Campus Gotland, with the aim of increasing students' skills in solving sustainability problems. The course took place in the spring semester of 2020 with the main goal of improving students' skills in formulating and solving sustainable challenges in groups. This was achieved by activating the heterogeneity of the group, seeking relevant information and facts, and organising and carrying out the task with a design-thinking methodology. Students were provided with real problems or challenges by tourist companies, authorities and other interest groups on the island of Gotland. The purpose of this study is to describe the group of students as well as joint learning processes and knowledge needed in the work towards sustainable solutions. The major implication of the study is that the course gave the students the opportunity to deepen their understanding of both the barriers and benefits of working with heterogeneous groups. Furthermore, the study revealed a number of factors that all organisations would need to take into account in order to improve the effectiveness of their work towards sustainable solutions.

Keywords: design thinking; group processes; heterogeneity; individual and collective learning; problem solving

1. Introduction

The labour market is constantly evolving and requires new skills, knowledge and qualifications over time. Knowledge-based economies of today require people with more developed and relevant transversal skills, such as the ability to think critically, take initiative, solve problems and work collaboratively. The development of transversal skills in higher education implies using innovative and student-centred pedagogical approaches [1]. According to UNESCO, higher education must adapt its structures and teaching methods to these new requirements. There is a need to change from a paradigm focused on teaching and the transmission of knowledge, to one focused on learning and the development of transferable skills to different contexts in time and space [2]. In our rapidly changing modern society, a strong distrust, among other reasons, has arisen for professionals who only know how to solve problems by applying existing theories and techniques, as they are generally ineffective in new conflictive situations that can occur. Innovation is becoming a requirement and a competitive advantage in working life. Therefore, it is an increasingly demanding and important issue. The current trend in higher education is improving creativity and individual students' thinking by bringing them closer to the world and complex problems that they will find [3]. All of these skills also

are highly demanded in solving the sustainability problems of modern day [4]. Moving towards a more sustainable way of living will inevitably require some radical changes in attitudes, values and behaviour [5–7].

We need to change the way we produce goods and services in order to meet our needs and remain within the limits of the carrying capacity of nature and ecological integrity [8]. This can also be seen as a basis for the development of national environmental policy. The World Tourism Organization, UNWTO, [9] describes the development of sustainable tourism as something that should take into account the current and future economic, social and environmental influences, and as something that should satisfy visitors, industry, the environment and the operators' needs. Collaboration between higher education institutions and society demands the open exchange of ideas, challenging personal and institutional boundaries. In the near future, there will need to be collaboration between territories of knowledge [10].

In this study, sustainability can be seen as a goal for any organisation to strive for. In order to understand the assignment and responsibilities it carries, there is a need for knowledge of problem-solving skills. Students becoming further educated in practical problem-solving skills can be seen as a process that can activate other processes that are important in understanding the meaning of the assignment as well as the concept of sustainability as a goal in an organisational context, rather than simply within the realm of sustainable destination development. For these reasons, the design of the course "projects in multidisciplinary teams" in the master's programme of sustainable destination development at Uppsala University has promoted problem solving, innovation approaches and collaboration with tourist organisations, encouraging students to work in teams and use design-thinking as a method.

2. Theoretical Perspectives

The following theoretical perspectives are considered to be of importance in describing the students' processes during the course.

2.1. Teamwork

Teamwork as a way of working has been studied by professionals and scholars extensively from a range of perspectives. Educational institutions also have a responsibility to teach students to work effectively in teams, because organisational performance depends on group synergy rather than individual contributions [11].

Teamwork competencies include knowledge, principles and concepts of the tasks and operation of an effective team. Furthermore, the set of skills and behaviours needed to perform tasks effectively are important, as well as respecting the attitudes of each team member [12]. Teamwork can be seen as a key competency and a prerequisite for university students in training analytical and systematic thinking in order to be able to collaborate with other team members and participate in decision-making [13]. There are several classifications in regard to the concept of teamwork, such as individual skills and abilities which are of importance in teamwork. Knowledge, skills, motives and traits are teamwork dimensions that are pointed out by [14]. Knowledge includes team process development, self-awareness, organisational roles of team members and knowledge of management [15]. Teamwork abilities can also be divided into three dimensions: affective, cognitive and behavioural. The cognitive dimension includes learning and innovation. The affective dimension comprises satisfaction with the team, viability, cohesion and identification with the team. The behavioural dimension regards concepts of quality and quantity of work and achievement of objectives [16]. Learning is a natural part of teamwork within a practical educational setting. Learning and group processes are interdependent and interwoven.

Communication skills in the group are important. Basic features of teamwork such as goal setting, problem solving, conflict resolution etc., cannot be attained without well-trained individual communication skills. The membership diversity in the group or team is widely recognised as a

factor of success. Heterogeneous groups with a variety of skills promote creativity in problem solving. However, communicative, cognitive, and cultural differences increase the potential risk of conflicts. Each group/team member influence the group process and vice versa. There are numerous ways by which group composition might be customised either to benefit students with particular needs or to emphasise particular outcomes [17–19].

2.2. Design Thinking for Problem Solving

Design thinking begins with a set of principles that frame a way to see problem.

Design thinking as an activity has been used in different disciplines since 1987, starting with industrial and graphic design as well as engineering and architecture [20]. Design thinking as a method and a model has lately spread into many disciplines. It has a multi- or inter-disciplinary character through problem solving and demands the ability to synthesise knowledge from a variety of sources [21–23]. That is why the problem-solving process frequently involves planning and sketches but also creating and using models and prototypes. These tools provide alternative paths to experiential learning and serve often as the basis for the accumulation of tacit knowledge. Consequently, they can help to discover a new knowledge or modes of thought [23,24]. Design thinking has been promoted even in university education by establishing programs that are focused on cultivating design thinking in countries such as those in the Asia-Pacific region, namely, China, South Korea, and India [25].

Design thinking begins with a set of principles that frame a way to see problems and solutions from a new point of view. These principles provide the foundation for delivering solutions that meet or exceed the users' expectations. These principles include a focus on user outcomes, diverse empowered teams, reinvention and solutions from a new point of view [26,27]. There have been some critics expressed on design thinking approaches, though. Some problems pointed out here are of ethical kind. When utilising the model, some users can manipulate available choices. This has been a problem mostly in projects with strong financial interests involved [28].

2.3. Learning Processes

2.3.1. Learning Individually

The concept of learning has been described through different scientific disciplines and perspectives throughout history and can be mainly divided into two main streams: individual and group learning [29]. In this study the main focus is theories that can bear relevance to the perspective on joint learning processes in higher education. Theories of individual learning are, however, crucial for understanding joint learning processes. Concrete experience is often emphasised in theories about individual learning. Experiential learning by Kolb is one of the theories. An individual experiences a situation, analyses it and understands the meaning and value of the particular situation in his or her own perspective. The experience is cognitive, affective and behavioural [30]. Experiential learning theory (ELT) can be seen as a complete, comprehensive method of learning. It regards how people learn, grow and develop, and accentuates the importance of experience in the course of learning.

Experiential learning theory is established on the fundamental concept of effective, straightforward, and personal experiences [31–33]. Kolb [32] argues that it can be defined as a cyclical process where individuals move back and forth between opposing modes of reflection versus action, and feeling versus thinking. Learning sustainability favours this perspective because it focuses explicitly on the relationship between cognition and action, rather than on the increase in an individual's stock of knowledge. However, Kolb's theory does have limitations. The focus in the theory is on learning from and through (primarily) individual experience. The theory does not take into consideration the contextual aspect, i.e., how some learning is influenced by social settings. It also overlooks the role of values and interests that influence human action. In the pursuit of learning sustainability, it is important to take both these issues into consideration [32].

Schön [31] integrates values and beliefs in a theory on learning. According to Schön, cognition cannot be separated from values and beliefs, nor can cognition and action. The importance of illuminating the relationship between learning and action, that is, between thinking and doing, by Schön [31] sheds light on the nature of the changes that an innovative project must seek to provoke.

Changes in so called theories-in-use that are often tacit remain implicit and go unnoticed. In order to challenge them, they need to be brought to the surface: people will have to be made aware of their tacit rationalities, and be tempted to reconsider them. A second relevant aspect of Schön's insights is that, even though theories-in-use play a role in the actions of various actors in a similar way, they differ in terms of contents depending on professional training and experience, social background, upbringing and so on. Because of their intrinsic and fundamental divergence, the theories-in-use that people from different professional and cultural backgrounds hold will influence the possibility for them to learn collectively, a topic which is to be discussed next [31].

2.3.2. Learning in Group

Group learning is more complex and dynamic than a mere magnification of individual learning. The level of complexity increases tremendously in the change from a single individual to a large collection of diverse individuals. Issues of motivation and reward, for instance, which are an integral part of human learning, become doubly complicated within groups. Collective, collaborative and collegial learning are terms often used in the context of joint learning processes. Collaborative learning can be considered as a special type of phenomenon, where the starting point is that all learning is based in social activities [34].

According to Granberg and Ohlsson [35] there is a difference between collaborative and collective learning. In collaborative learning, a group of individuals is trying to learn something together but without the specification or clarification of the social context. In collective learning, however, it is decisive to try to achieve a common understanding. It is important for the collective learning that the experiences are described in the collective so that the group can jointly problematise and reflect on the experience [36,37].

Action learning is an approach pioneered by Revans [38]. According to him, learning can be witnessed only through some form of noticeable change in behaviour. Change is essentially a process involving learning and action. Without learning there can be no action; without action there can be no proof of learning. Action learning has become one of the most widely used instructional methods, particularly in organisational development in both public and private organisations [39]. The growth of action learning is attributable to the notion that participants best learn new behaviours and problem-solving skills through real-world issues [40,41]. The action learning approach, developed by Revans, is crucial to examine learning cycle. This approach facilitates people and organisations to change by developing a social approach to learning. It is an effective learning process that helps participants in finding a satisfactory answer to difficult unsolved problems. In action learning, participants typically work in small groups where they meet regularly to solve the issues encountered by them. They analyse and develop solutions, choose the most appropriate one, and implement their recommendations. Throughout the process, learning and task achievement go hand in hand. Action learning is primarily a way of managing change through a learning process. Learning consists of programmed instruction and questioning insight [38].

Team-based learning (TBL) is a collaborative learning and teaching strategy that enables people to follow a structured process to enhance student engagement and the quality of student or trainee learning. The term and concept were first popularised by Larry Michaelsen, the central figure in the development of the TBL method while at University of Oklahoma in the 1970s. The method was created as an educational strategy that was developed for use in academic settings, as in medical education. Team-based learning methodology can be used in any classroom or training sessions at school or in the workplace [42].

To summarise the aspects of learning mentioned above, it can be stated that learning is valued in this study as a process by incorporating both individual and group learning processes. Working in groups or teams are also influencing learning approaches. Group dynamics is a system of behaviours and psychological processes occurring within learning and can sometimes be problematic [43]. The period of collaboration in learning at times can lead to confusion, differences of opinion, and conflicts [44].

However, interacting with diverse co-learners often creates a discontinuity [45], which reveals hidden assumptions and helps to gain a broader view of the whole learning process [46]. This active and effortful practice improves academic performance and makes students more inclusive and democratic [45]. Furthermore, the motivation to learn can be enhanced through the social contexts of collaborative learning as students work together to overcome challenges (e.g., differences in opinions in the group, task requirements etc.) to complete an assignment [47,48]. Students engaging in group work are simultaneously developing their own skills of self-regulation in their learning by increasing their skills of metacognition, motivation and behaviour [49].

Despite these benefits, also challenges exist with implementing collaborative learning structures. When students are assigned unstructured collaborative tasks, they work independently, bringing together their tasks at the end to finish the product, according to Cohen [50]. Slavin [51] noted that when the group task is to do something rather than to learn something, the participation of less active students may be seen as an interference rather than help. If tasks are not structured and students are not given clear expectations and instructions, collaborative learning may not lead to successful academic outcomes.

These theoretical perspectives, presented above, are used in this study as a foundation for analysing and understanding the processes involved in the interaction and collaboration between group members and course leaders, especially when utilising the design-thinking model in the context of problem solving. Furthermore, these processes can be considered as a framework for understanding the complexity of learning about issues of innovative problem solving in any group context.

2.4. Method

"Projects in multidisciplinary teams" was a course developed as a part of an international master programme in sustainable destination development at the Gotland campus of Uppsala University, and it took place in the spring semester of 2020. The programme was running on its second year with 58 students of 35 nationalities enrolled. The aim of the programme is to provide students with competence and knowledge that will enable them to engage and work with destination development that leads to increased sustainability for all parties, visitors, hosts and locals. The location of the programme, the island of Gotland in the Baltic sea, has not been chosen by coincidence for the study. Gotland is an established destination with tourism as its major economic sector. The programme has the ambition, by virtue of its location on an island, to act as a living laboratory, i.e., to let students deal with real destination development cases and challenges during their studies. The university and the programme have a high degree of collaboration with the local community, businesses, organisations and public authorities. The programme also uses a pedagogy of ESD (education for sustainable development) in which learning by working together is emphasised [52,53]. Teamwork is crucial, as sustainable solutions are hard to be achieved single-handedly. The Sustainable Development Goal, number 17, Partnership for Sustainable Development, indicates the importance collaboration of different stakeholders and sectors in society.

The programme has three specialisations: entrepreneurship, nature-based tourism and heritage politics. The students were working with real sustainability challenges in regard to destination development at Gotland that local actors, companies, organisations and public authorities provided them with. This year the students were engaged in 11 projects. Students in heterogeneous groups of three or four members were faced by these challenges. One of the expected learning outcomes was to make use of the heterogeneity in the group when solving the problem. The external stakeholders

presented their challenges to the class, the student expressed interest in specific ones, and then the teacher composed the groups to ensure heterogeneity.

A qualitative approach was used in this study. During the project course, teachers had continuous meetings with the groups of students. At these meetings, the students presented the progress of their work at the campus, and they received feedback and feedforward from each other and the teachers. The teachers attended the final presentation of the proposed solutions. The teachers had focus group interviews with the groups of students about their perceptions on learning. Furthermore, five problem owners responded to an online survey.

The study presents and analyses the responses of 6 study groups comprised of 3–4 students per group (a total of 22 students) and answers from 5 problem owners who answered 19 questions related to the broader question of: "How did you as a client experience the students' contacts and process of problem solving?" The analysis follows the questions in the interview guide and is interpreted based on the theoretical perspectives described in the theory section.

The interview guide for the students contained questions about the study background, members of the study group, the problem owner and the assignment or the challenge given to the students; the description of the whole process, including 13 questions and specific questions regarding the method used in the course, the so called design-thinking method (4 questions); group processes (8 questions) and questions about student learning (5 questions). In addition, the responses from the questionnaire sent to problem owners are presented and analysed, containing 19 questions about how they experienced the student project.

Study groups consisted of three to four members all from different nationalities and with different study backgrounds. The students in this study came from 14 different countries: Czech Republic, Germany, Austria, France, Finland, Brazil, Mexico, Indonesia, China, Italy, Iran, USA, Spain, Vietnam and Kazakhstan. Problem owners were entrepreneurs in the tourism industry. In Table 1, the entrepreneurs and the assignments/challenges/problems that the students performed group interviews regarding are presented.

Table 1. The entrepreneurs and their challenges given to students.

Entrepreneur	The Challenge
Gotland Excursion	To map how accessible the city of Visby is for people with disabilities and to make suggestions for improvement. Design a sustainable tour for the disabled.
County Board of Gotland	How can the use of plastic in the tourism industry in Gotland be reduced?
Uppsala University	To organise training on sustainability for BnB organisers.
Tourist attraction Lummelunda cave	Designing for more user areas of the attraction.
Village development of Hemse	To develop Hemse as a place and destination.
Roombler	To develop a membership programme for the site.

3. Results

3.1. Experiences of the Whole Process by the Students

The responses of the students are based on the different phases of their process, and the answers here are compiled using the same steps as the tool for problem solving in design thinking: "empathise"—understanding and defining the problem; "ideate" i.e., generating new ideas; "prototype"—the building of real tactile representations i.e., exploring; "test"—returning to users for feedback; and "implement"—presenting the solutions, i.e., materialising.

The students' answers show initially that it was not easy to slip into the problem owners' shoes and try to understand their needs. Some of the students argue that it was hard to define the real problem

for several reasons: the students themselves had their own ideas of what the problem was, and there were so many different problems that it was difficult to define one target group. They struggled with issues of communication and with the large amounts of information. Additional difficulties were also encountered due to the fact that they could not discuss the matter with outsiders due to confidentiality and business secrets. Further on in the process, the students noted the process went on more smoothly with each step. The process often started with brainstorming due to the students' lack of knowledge of the area. They then started talking to people and gathering information, which helped then to discover the target groups and define the problem. In order to be able to concretise the problem, the students used the tool "5 'why?'s" (not asking the informant "why?" only one time, but five, to gain additional information to that provided upon the first explanation), paid a visit to the problem owners, experienced the area by talking to the owners and locals, looked for similar information online and obtained some feedback and feedforward from the course teachers and co-students during the weekly meetings at the university. Some of the groups used also qualitative interviews, semi-structured open-ended questionnaires for data collecting and testing a prototype of the problem area. Some pointed out that they were using their own life experiences. Having to go back in the process according to the diamond model in the design-thinking approach was perceived as both good and frustrating by the students.

When asking the students how the quality got improved with their solution proposals, they emphasised that the usability of their proposals increased among users. According to them, taking time to see what problem owners actually wanted help with allowed them to become more aware of other alternatives. Subsequently, this helped them to improve the quality of their proposed solutions. One of the goals of the course was to increase sustainable solutions in the hospitality industry. The solutions that the students would present had requirements to take into account the sustainability goals. Depending on the nature of the projects the students worked on, the various sustainability goals were highlighted through the responses. The solutions to problems were successfully experienced by all groups. Presentations were carefully prepared by the students, including many creative and innovative elements. The problem owners were invited to attend these presentations at the university. The problem owners expressed their appreciation of the solutions and wanted the students to come to their organisations and further explain their solutions.

To summarise the students' experiences of the process, it can be stated that the course and the method used were perceived by the majority as rewarding. However, some are critical and claim that the design-thinking model is too steering and rigid. Some felt that they did not have sufficient knowledge of the method when the project started, despite being given two full days of introduction to the method. Despite this, most students would like to use the method in the future for problem solving.

3.2. Problem Owners' Experiences of the Students' Process

Problem owners testify that they chose to participate in the course with their projects and problems in order to gain new inspiration and help with innovative solutions or, e.g., keeping an old project alive. To the question how they experienced engagement with the students, problem owners answered in the following manner:

> 'Took a while before I could be sure they understood the mission but well worth the time when it ultimately exceeded my expectations.'

The parties met each other 2–3 times during the course and some as much as a few times a week. The meetings took place both physically and digitally. Problem owners offered the students material in the form of brochures, documents, pictures, links and contact information for companies as well as interviews. They also argued that it is difficult to get into a business in a short time in such a way that make it possible to deliver something of value. Problem owners participated in student presentations of solutions, both in person or via a link. Most of the problem owners were very satisfied with the solutions, but some thought that the students had misunderstood some of the information.

It would have been better if the students had discussed their solution in advance in order to correct any misunderstandings and ambiguities. In regard to issues of sustainability, problem owners noted that student work has provided inspiration for an upcoming project in sustainability. All involved entrepreneurs also want to continue to participate in similar projects. Problem owners replied that they have learned the perspective of other countries and cultures on their own issue. Thus, having reasonable expectations of results and finding areas for development, a course like this can create value. If students are given a reasonable task that creates value, then clients are likely to be satisfied with the outcome.

When asked what the greatest benefit of participating in this project was, the problem owners responded with the following: the students solved my problem, the results, meeting new students and taking part in their approach and analysis, inspiration for continued work and, finally, collaboration with other organisations. Several problem owners also noted the shared benefits with continuous collaboration between the university and companies.

3.3. Student Group Processes

The students were divided into so-called heterogeneous groups. The members of the groups came from different countries and cultures. They had been chosen from three different tracks of education. This heterogeneity was one of the course objectives. The students had not previously worked in these group constellations. What can be learnt from the students' answers is that the experiences of working in these groups during the course were varied. Some groups testify to difficulties in cooperating, sharing roles, leading groups, dealing with conflicts and communicating with each other. On the other hand, others seem to have found ways of working with suitable strategies at once.

> 'We were lucky to mostly be on the same page. Good to be free to be sincere, we could be open to express disagreement, very productive, not losing time on diplomacy or politically correctness, instead direct, really productive'.

> 'Too much different ideas, challenge to agree.'

> 'Intense with long days, needed a break sometimes, none took it personally. Reflecting on what to do, can take a long time.'

Conflicts in the groups seem to consist of disagreements on who is the leader, different ways of doing things, different competencies and meeting routines, time keeping, not understanding each other and the challenge of consensus decisions. Sometimes the students express both benefits and challenges of working as a group.

> 'People worked too fast, needed to slow down. They had different skills and target areas, special areas of knowledge and complemented one another.'

> 'I have never done anything like this before, never worked with real world issues.'

Not only working in this group constellation can cause problems for the students: working with the outside world can also be challenging. Working methods seem to be varied among student groups. Some of the groups choose meeting on regular basis physically, some others via digitals solutions and/or on a more meeting when necessary basis as opposed to appointment schedules. The students described the surplus value of the course as completely positive. They seem to understand the benefits and the power of working as a group instead of working and studying alone. Real problems are to be regarded as a huge motivator and seem to increase responsibility in the group.

> 'Co-creation, ideas activated by others in the group, would have not been able to do this by my own, a real discovery.'

'It felt like we were doing something helpful, with impact.'

'That is very motivating, we cared a lot more, when working with real stakeholders.'

'We became friends (two of us).'

One of the group expresses the process on the whole as follows:

'Easy, no problem, very open, no fixed idea. We had very different pre-knowledge. The process kept us open-minded, the tool kept us do things differently, from broader perspective. The tool is powerful to not get stuck in specific thought.'

3.4. Learning in the Group

The learning outcomes in this course, expressed by the students, were e.g., giving and obtaining feedback to each other, learning about Swedish society in general and the island of Gotland, as well as city of Visby in particular. The opportunity to learn some valuable skills was also mentioned by the students.

Skills, such as learning motivate each other, being flexible, and interaction and organisation, were mentioned. The students did learn not only about their fellow students but also about themselves within the group work. They also pointed out how difficult it can be to try to teach somebody else, especially when trying to change their behaviour. The students seem to appreciate the benefits of working together when faced with real life challenges.

'The group came up with things I would not have thought about myself. Good that we did everything together, rather than divided it up.'

'I learnt a lot, because I was not frustrated at all, that is new to me in group work, learnt from different interdisciplinary competences.'

'I learnt a lot in a positive way. It was an enjoyable way, became friends, etc. which promoted learning. Liked interacting with all the group members. Got to know the members quite well, beyond the professional things, personally.'

The method was challenging for the students, at least in the beginning of the process. Further on, however, they seemed to learn the benefits of not having all the pieces on the table at once. They affirmed that they learnt the methodology of design thinking by doing. The greatest achievements were seen during the month where the students used a hands-on approach with the additional help of useful weekly guidance by the teachers. There are, still, some students who had wished that the teachers had provided more assistance and supervision in the beginning, and more than weekly. Ultimately, the students were happy with the course and how it was performed. Learning by doing in heterogeneous groups was highly appreciated by the students.

3.5. Summary of the Results

The development of transversal skills in higher education implies using innovative and student-centred pedagogical approaches [1]. Furthermore, Uppsala University promotes approaches through the guideline called "teaching and learning at Uppsala University, 2018", which contains visions for the university's teaching and learning activities and their further development [3]. Uppsala University aims to promote problem solving, innovation and collaboration among students working in teams and using design thinking as a method in the project course of the sustainable destination development master programme.

The students' answers show what is important in teamwork. According to Cannon-Bowers et al. [7], teamwork competencies include knowledge, principles and concepts of the tasks. Furthermore, this set of skills and behaviours is needed to perform tasks effectively and have a respectful attitude towards

others [7]. The students mention all three teamwork abilities in their responses. The three dimensions, namely, affective, cognitive and behavioural, become visible in responses where the students talk about how they feel about working as a team, how they are working and about the results of the teamwork [16]. Communication skills are regarded as very important in teamwork. The students witness the importance and benefits of the group's diversity, even though they are aware of the risks of conflicts and disagreements due to cognitive, communicative and cultural differences [17–19].

Design thinking as a method seems to help students to gain and organise the knowledge needed for problem solving in the project [21–23]. However, this method also created confusion and frustration among the students (especially in the beginning) because of the iterating process, the new way of approaching the problem and the students lacking experience working as a team [26,27]. It appears that considerable time is required to become a team that works effectively, as various elements need to be initially established, e.g., determining the roles in the group, choosing the leaders and working methods, organising the time schedule, etc. This has been pointed out as weakness of the design-thinking method by the students. Design thinking has been experienced by some of the students as a gauge that does not promote creativity and, instead, is controlling and too predictable. The students also noted that it could be manipulated by strong leaders.

Learning in the course can be described through many different theoretical perspectives, mainly divided into those of individual and joint learning theories of learning. The course can be considered as a process or a project with a starting point and an end. Then learning and group processes within them can be explored based on several theories. Kolb [32] points out the importance of experiential learning which seems to have taken place in the problem solving and learning in this project course. The model of design thinking follows Kolb's thoughts on the process, offering cyclical processes where individuals move back and forth between opposite modes of reflection versus action [32]. Schön [31] adds values and beliefs in a theory on learning and argues that they are important for innovative projects because they provoke tacit knowledge. This is something respondents in this study witness by talking about benefits of working in heterogenous and culturally diverse groups. After the initial training in design thinking, the groups began the work by brainstorming. This way of working together can be considered as collaborative learning where students are learning together, but what they learn is not necessarily the same thing [35]. When students learn collectively, they need to come to consensus decision regarding their common understanding of the issues or phenomenon as well as their plan for the next step in the process.

Action learning [40,41] appears to be a favourable way of learning for learning new behaviours and problem-solving skills through real-world issues. This is the way students act when collecting data for their projects. Meeting stakeholders, approaching problems by visiting places, interviewing their informants etc. offer the students new knowledge regarding the challenges. By following the structure of design thinking, the students also apply so-called team-based learning (TBL). TBL is a collaborative learning strategy that enables people to follow a structured process to enhance student engagement and the quality of student learning [42].

Problem owners also influences students' learning by motivating and offering a social context and real-life experience. Based on their statements, this varies with the amount of collaboration and communication with the students during the project. They also testify that this collaboration with the students has led to learning by themselves. They also noted that they gained inspiration and knowledge in regard to solving problems surrounding sustainable art. All problem owners seem to be very pleased with the results that the students achieved and want to continue collaborating with the university. The process of problem solving experienced by both the students and problem owners is continuously being developed.

4. Discussion

The major implication of the study is that the course has given students the opportunity to deepen their understanding of both the barriers and benefits of working with heterogeneity in groups.

Accepting the contributions of others and putting their own competence at work, with the help of design thinking as a method for problem solving, as well as interacting and discussing with beneficiaries and problem owners, increased the students' learning capacity. However, we also note both the possibilities and limitations of design thinking as a method. Some students found the design thinking-methodology to be a supportive structure for their work, while others find it constraining. We see this as part of the general dilemma in trying to find the right balance between freedom and structure involved in any group work. We conclude that methodologies other than design thinking could be tested in this regard.

What can ultimately be found throughout the study are a number of contradictory factors that appear to be noteworthy when trying to maintain balance in all organisations that strive to improve their teamwork (see Figure 1 below).

freedom	⟷	structure
heterogenity	⟷	homogenity
collective responsibility	⟷	individual responsibility
group learning	⟷	individual learning

Figure 1. Contradictory factors striving for balance.

These factors or dimensions, as our study shows, are used in describing how group work could be organised more effectively. These dimensions could further be seen as each other's counterpoints or even a field of tension, where the influencing factors move in accordance to each other's position. These factors are rarely completely balanced, but problems arise in group work when factors move too much to one side or the other.

If the group's work is too structured, strictly following a model or detailed instruction, the group's work can be perceived as too instrumental. This, in turn, can stifle the creativity and innovation ability of the group members. Conversely, if the group's organisation is too vaguely structured, allowing for too much freedom, it can cause a spectrum of activities that is too wide, which poses the risk of losing the focus of the assignment. Too much homogeneity can cause the risk of so-called "groupthink", which is the practice of thinking or making decisions as a group, resulting typically in unchallenged, poor-quality decision-making. The group risks using too few facts and arriving at a consensus decision without having discussed alternatives. Again, heterogeneity, drawn to its outmost, does make it hard for a group to come to a decision and to find a consensus. Furthermore, the work process can become very time-consuming. This situation can create conflicts in the long run, which in turn complicates and delays the work.

In all group work, it is important that responsibility is taken and shared between the group members. Equally important is how the group relates to accountability demands. Too much freedom causes lack of responsibility. Then, one does not consider the best interests of the group but considers the individual responsibility as more important. This appears to be counterproductive to teamwork. It can also enable the existence of so-called slackers or free passengers in the group. To rely too heavily on the instructions and follow them too carefully, without being flexible in any matter, can stifle the creativity and innovation ability of team members. By relying on and following the rules of the model, one runs the risk of not being exposed to alternative possibilities and ideas. Again, the other extreme of being too responsible or taking too much responsibility in the group creates a risk drowning in responsibility. Thus, not being able to share responsibility with others in the group or team can be equally as damaging.

Regarding the balance between learning individually and in groups, it may be fatal for the group if individuals feel they are not able to share their knowledge and experiences with others in the group. The opposite is the danger that knowledge sharing can become social engagement which subsequently weakens the content of the shared knowledge for group learning.

With these perspectives in mind, especially the need to strive for balance, we now conclude the study by pointing out that all group learning in organisations, and especially in regard to sustainability, needs well-functioning processes that can lead to organisations competently conducting work in order to find sustainable solutions.

Limitations of the Study and Further Research

The purpose of this study was to describe student group and joint learning processes and knowledge needed in the work towards sustainable solutions. The major limitations of the study were that only 6 groups of 11 wanted to participate in the study. Furthermore, five of six problem owners answered the inquiry. The interviews were organised as focus group interviews which may mean that respondents cannot or do not want to speak to a large group about their experiences. It would have been more interesting to conduct individual interviews with the inclusion of group members. As further research, it would be interesting to follow these students in their further studies and work in groups. Methodologies other than design thinking could be tested as structures for working in groups. Furthermore, a study consisting of an investigation of the balance of contradictory factors (e.g., structured–loose structure, homogeneity–heterogeneity, accountability–responsibility, individual learning–group learning) that appear in group work would be of interest.

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