Exploring the Importance of Self-Study Time. A Design-Based Research on Students Group Work

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Abstract

Group work and social learning are important aspects in instructional design of higher education. They are expected to promote students' activity, increase their motivation, or provide further subject-based learning outcomes. Additionally, students should develop their ability to cooperate and collaborate, which is expected by employers, among others. In practice, it seems that these hopes are often not realized: the quality of outcomes and group processes falls short of expectations on both sides, teachers and students. This article explores how lecture and self-study phases of a STEM course could be linked in a way to promote students' group work skills. To address this problem not only theoretically but also with perspectives on educational practice, a design-based approach was chosen. Based on the existing subject-teaching concept, a learning path for group work skills was designed and implemented, including a Moodle learning space. Continuous reflection on group dynamics and further assignments had to be submitted according to an underlying team development process.

Keywords: *Group work, social learning, collaborative learning, design-based research, higher education*

1. Introduction: The Tragedy Of Group Work

Imagine the following scenario: In the first lesson of an engineering course on construction, the lecturer outlines the module and explains the exam. Students will be required to develop a technical solution to a problem in the industry through a project-based process. This project, a semester-long group assignment, is designed to meet contemporary teaching methods that emphasize authentic problems and small-group collaboration. However, student reactions are less than enthusiastic. Without knowing the specific task, many students immediately focus on team formation, disregarding the skills necessary for an effective problem-solving.

This scenario exemplifies the tragedy of student group work: intended to be challenging yet motivating, group work aims to deepen students' knowledge of the subject matter. It is assumed to offer benefits such as diverse ideas, division of labor, enhanced communication skills, critical thinking, problem-solving abilities, and teamwork competencies [1]. However, students often find group work exhausting and frustrating, and believe that success depends primarily on the composition of the group. Furthermore, they rush to divide tasks and minimize direct interaction, undermining true collaboration. While doing the group work, students feel isolated with group issues, but rarely escalate problems for various reasons. Instead, some overcompensate for others' underperformance. When it comes to assessment, the tragedy manifests: lecturers may not see the expected increase in knowledge and group work skills, yet groups pass the exam without functioning as a group. Intended for the better, it turns to the worse: every negative experience in group work may lead to an increasing negative attitude towards group work and through this counteracting the initially set out instructional goals [2].

Improving this situation requires dispelling the belief that simply engaging in group work is sufficient for acquiring the necessary skills for effective collaboration [3]. Additionally, the self-study period is of particular interest, as it is during this time that group activities are conducted. In general, the structuring and supervision of self-learning time does not seem to be typically pronounced by lecturers, especially in face-to-face programs [4]. This article explores how students' group work skills can be intentionally promoted through an integrated teaching concept explicitly addressing self-study time. This innovative approach combines the required group work with learning units on group work skills and aims at understanding better the potential for resolving the tragedy of group work.

2. Methodological Approach

2.1 Design-Based Research

To address this question not only theoretically but also with perspectives on educational practice, a design-based research project has been initiated. Design-based research (DBR) is a research methodology characterized by several key elements, among them its aim to intervene in educational situations to change and understand them better and to develop theories about learning [5]. To further guide the research, the Research-through-design (RTD) approach has been chosen. In this approach, design becomes the vehicle to gather new knowledge so that the phenomenon and its context can be understood better. Consequently, the research is based on the empirically observable phenomenon of group work and leads to an explorative way of inquiry. Researchers are enabled to continuously learn and deepen their understanding as they develop new practical solutions, empirical insights, and local theories [6].

2.2 Context of the DBR Project

The DBR project is anchored in the teaching concept of a lecture on productional development. Students followed a construction process using CAD software, working on an object derived from an authentic industrial context, completed with detailed information and requirements. The module was assessed through a project work undertaken in groups, resulting in a group mark. Once groups were formed, they last for the semester. The work process was structured according to a project management approach, which defines different work phases ('stages') and milestones ('gates'). Groups had to deliver and present partial work at several gates. Classroom sessions provided systematic and methodical problem-solving instructions, along with specific case requirements. Some in-class exercises were done in groups, but most of the group work took place during the self-study period. The module description outlined the expected self-study workload, which included lecture preparation and review, knowledge application, and exam preparation. Self-study time was set at one-and-a-half times the in-class time. The distribution of tasks and the management of the group process is mainly left to the students. In this project, however, the groups had to present the result of a group reflection at each gate according to a pre-defined scheme. The teaching concept can be summarized as a problem-oriented teaching concept in which students work independently in groups to develop a complex solution to an authentic problem.

3. Design Process

3.1 Design Subject and Conjectures

To design an intervention for the existing teaching concept, the following instructional aspects were considered:

1. Subject related skills vs. social skills: Different relevant skills can be linked or stand side by side at the level of outcomes, tasks, and assessment. The integration of group work skills goes beyond the use of social interaction as an alternate method, even when small groups are used as a means of instruction. Required social skills need to be taught as deliberately and accurately as other academic skills [1]. For both types of skills, learning objectives should be formulated, learning activities designed, and outcomes assessed. Furthermore, these objectives, activities, and assessments should be interlinked.

2. Topic vs. task: The subject-specific design of the content of an assignment (topic) and the methodical design of a group assignment (task) should be taken together. The way in which topic and task are aligned shows the extent to which they are interdependent. On the one hand, a more challenging task requires collaboration, and on the other hand, effective collaboration is needed to enable a deeper discussion of the topic. Collaborative, task-related skills cannot be learned through simply 'being a group', but require specific learning activities [3, 7]. The promotion of explicit collaborative learning activities should support groups in acquiring deeper knowledge about how to successfully complete the group task and thus improve the overall performance.

3. Outcome vs. (group) process: The criteria for the final assessment influence the learning and group work process. According to Reeves, it is particularly important to assess those skills that can be called meta-outcomes of higher education, as they will not be learned if they are not assessed [8]. However, groups are not predetermined, but develop over time [9]. This development may be guided by a

particular learning environment, but still has its own emergence over time. Assessing only the outcome of group work can lead to the excuse of non-collaborative behavior [3]. By shaping and elevating the skills derived from the group work process as an important learning outcome, attention is given to the quality of that process. This should increase the collaborative quality of the outcomes.

In summary, these conjectures inform decisions about the teaching concept, serve as a framework for reflection and evaluation, and provide a perspective for the generation of knowledge. In the design of the learning path, the timetable of the subject lecture is understood as a pacemaker for the acquisition of social skills. The stage-gate process, which defines formative assessment, is used to design learning units that promote group work skills. Following a rhythm analogous to the lecture schedule, students are expected to complete work steps and submit tasks related to their group's development (see Figure 1).
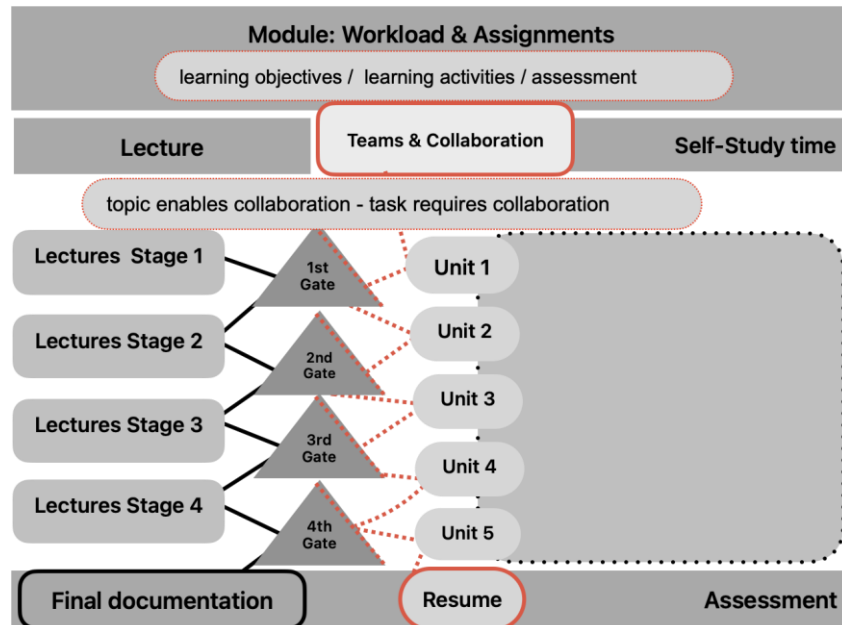

Figure 1: Integrated learning path, own illustration.

3.2 Technological Design of the Prototype

The university employs Moodle as virtual learning platform for all courses. Consequently, a Moodle-based learning space ('Teams & Collaboration') was created to realize the learning units incorporating appropriately designed elements. This arrangement represented a didactic pre-structuring of self-study time while preserving student autonomy as self-directed learners. According to Berg this included, among others, stable groups supported by learning counsellors instead of teachers, structured learning material for practical application, and the flexibility for students to adapt learning process and intensity to their needs [4]. Consequently, groups were offered consultation with a peer tutor, but were expected to work independently. The instructional task design evolved from a strict, timebound framework to a more flexible process. The participation in the complementary learning path was voluntary. To encourage engagement, student could earn bonus points for active participation. A balance between theoretical information and activity-oriented guidance was maintained, with each unit comprising various informative elements and activity-oriented tasks.

The elements included can be categorized based on the learning activities and the task design (see Table 1) [10]. Text, audio, and video provided insights into typical social phenomena during different group development phases, strategies for addressing group work issues, and the purpose of selected tools and methods. Five units followed on the group work process, two units provided additional materials and tools. Tasks promoted individual (Individual Reflection; IR) or collective reflections (Collective Reflection, CR), the processing of provided information (Information/Knowledge; I/K) and facilitating of specific group activities (Group activities; GA). Each unit required a group meeting focused on a particular aspect of group dynamics and the result had to be uploaded as a group product (Group Product; GP). The tasks were sequentially designed to build on each other in terms of knowledge and methods, aligning with the project's stages. Each type of task was repeated across

different learning units. For each completed task, students earned individual points, which were then converted into the grading scheme.

Following Salomon & Perkins, this alternation of activities can be described as reciprocal spiral relationship between individual and social learning, encompassing various aspects of mediated learning: mediation by cultural artifacts and active social mediation at different stages of the problem-solving process, leading to learning for both the individual student and the collective entity [11].

Table 1: Learning elements used, own illustration based on Würffel [10].

Activities (individually or in group)	Tools (based on Moodle)	Task Type
Connect to prior knowledge	Quiz, Database, Drag & Drop	IR
Reflect and share former experience	Database, Reflection Tool	IR / CR
Develop and share knowledge	Reflection Tool, Video, Test	CR, I/K
Collect and manage tasks	Board	CA
Develop group related artefacts	Assignment	CA, GP
Reflect group process	Board	CR / CA
Lead and moderate group meetings	Assignment	CA
Reflect learning process	Assignment, Feedback	CR / IR

4. Preliminary Empirical Analyses of the Prototype

4.1 Engagement in the 'Teams & Collaboration'

In the winter semester of 2023/24, 74 students enrolled in the 'Teams & Collaboration', corresponding to those enrolled in the main lecture. They were assigned to groups of 5-6 members. Activities were tracked based on the (self-reported) completion of tasks at the individual level. This allowed to recapture the engagement over the learning units 1 to 5. Due to changes in the lecture schedule, the dates of the gate presentation were adjusted. Since the content of 'T&C' is also aligned with a group development process, some tasks depended on the duration of collaboration rather than specific dates. It was decided to decouple the timeframes of the lecture and 'T&C' for Gate 2. Additionally, Gate 3 and 4 were scheduled close together, which was also reflected: Unit 5 accompanied the last group phase of elaborating the final technical documentation after the Gate 4.

The activity tracking results show an uneven pattern of engagement (see Figure 2). One reason for this may be that individual and group tasks were tracked on an individual basis. This leads to higher activity rates whenever a group task was uploaded, as this activity was recorded positively for all group members, regardless of their individual participation. An example of this is the high score at the end of Unit 2. Additionally, consultation hours and the preparation for gate meetings influenced task completion.
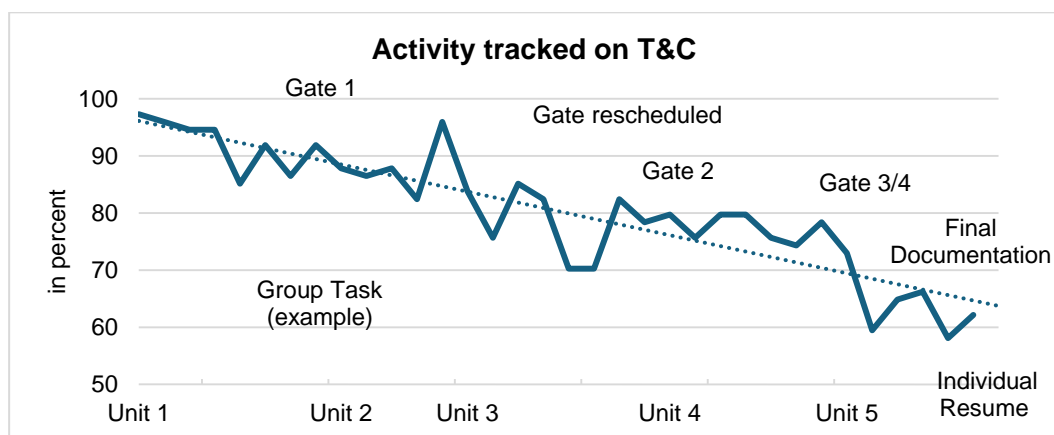

Figure 2: Student Engagement in the Moodle learning space, own illustration.

The decline in participation rates can be attributed to several factors. Firstly, group assignments were challenging because some students enrolled in the course weeks after it began and had to join existing groups. These teams did not repeat the initial units with the new members, instead they

focused on more subject-based tasks. Secondly, during Gates 1 and 2, some teams struggled with group compo-sition due to varying language skills and topic-related capabilities. Lastly, some teams felt they did not need to learn additional group work skills or did not consider them relevant, leading them to submit only the minimum required tasks. Additionally, the progress of the lecture provides further insights: the Gate 2 assessment was particularly challenging, requiring all groups to rework and present their results again. This led to significant demotivation and increased pressure among students. Furthermore, due to exam weeks, there was a four-week gap between Gate 4 and the final documentation, which influenced the quality of the collaboration in the groups and the activity on the T&C.

4.2 Group Work Skills

In the learning unit 5, students were asked to reflect on their own learning process. In this context, the Groupwork Skill Questionnaire (GSQ) was included. The GSQ is based on 10 empirically validated items that focus on two factors: task-related and interpersonal skills [12]. The questionnaire demonstrates good validity and reliability, making it suitable for assessing student perceptions of group work.

A total of 46 students completed the questionnaire, with 44 responses regarded valid for analysis, reflecting varying levels of agreement with specific questions. For the purposes of analysis, the questions have been regrouped according to the two factors. The mean value for each question and for the factor has been calculated (see Table 2). Cumming et al. note that a greater proportion of students report the use of interpersonal skills in a group setting than the use of task skills [12]. This analysis shows a similar pattern, although the difference between the means is not particularly pronounced. Notably, open communication and mutual support emerged as the most highly rated skills, whereas taking on organizational roles and providing emotional support received lower ratings.

Table 2: Analysis of the GSQ, own illustration based on Cumming et al. [12]

	Mean values*	
Interpersonal Skills	**(N=44)**	**3.98**
Provide emotional support to my group members.	3.48	
Be sensitive to the feelings of other people.	3.80	
Show that I care about my group members.	4.07	
Be open and supportive when communicating with others.	4.34	
Be there for other group members when they need me.	4.20	
Task-related Skills	**(N=44)**	**3.64**
Remind the group how important it is to stick to schedules.	3.39	
Construct strategies from ideas that have been raised.	3.73	
Clearly define the roles of each group member.	3.66	
Move the group's ideas forward towards a strategy.	3.73	
Evaluate how well the group is progressing towards agreed goals.	3.70	

* Average assessment of own behavior (1= never, 5 = always)

4.3 Social Interactions in Self-Study Time

Due to the general stage-gate approach of the lecture, it was assumed that social skills are mainly acquired during the self-study period, as the required group work will then take place. As a result, group membership was a prerequisite for participation in the T&C learning space. However, tasks were predominantly individualized, requiring students to integrate individual learning activities with social learning activities within the group. To investigate these patterns of social interaction, interviews were conducted with students from various groups to understand how groups structure their work during self-study. Preliminary analysis revealed that task and time management posed significant challenges: teams struggled to find suitable timeslots for meetings, leading to increased individual learning activities among other challenges. These findings were analyzed using the blended learning model of Würffel [10]. It becomes clear that the self-study time itself needs to be conceptualized in more detail (see Figure 3). Group work-related activities are not limited to group settings but are also undertaken individually. Individual learning activities may be linked to group work skills or pursue

different goals. Social interactions in the learning process extend beyond the group as a source of learning.
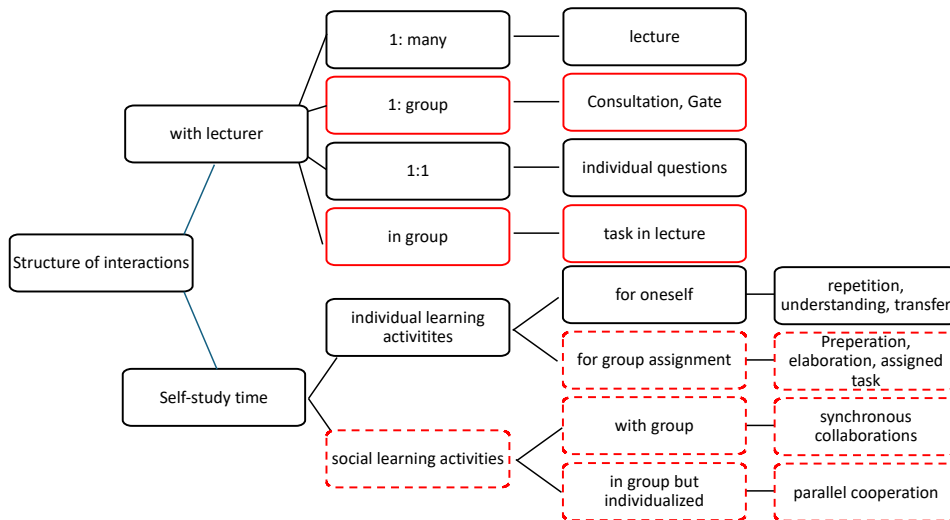

Figure 3: Structure of work and interaction, own illustration based on Würffel [10]

5. Discussion

The initial insights into the group work process were employed in two ways. Firstly, they were used to adapt the structure and information presented in the 'T&C' throughout the semester. Secondly, they were used to refine underlying conjectures and discuss new design requirements. One such discussion was conducted in the light of a group work model proposed by Gregory and Thorley, resulting in modifi-cations to the model [13]. The model describes three distinct action lines to explicate the role of groups in group-based learning. The first line refers to learning about a topic, the second to learning about oneself and groups, and the third to learning about completing tasks within a group (see Figure 4).
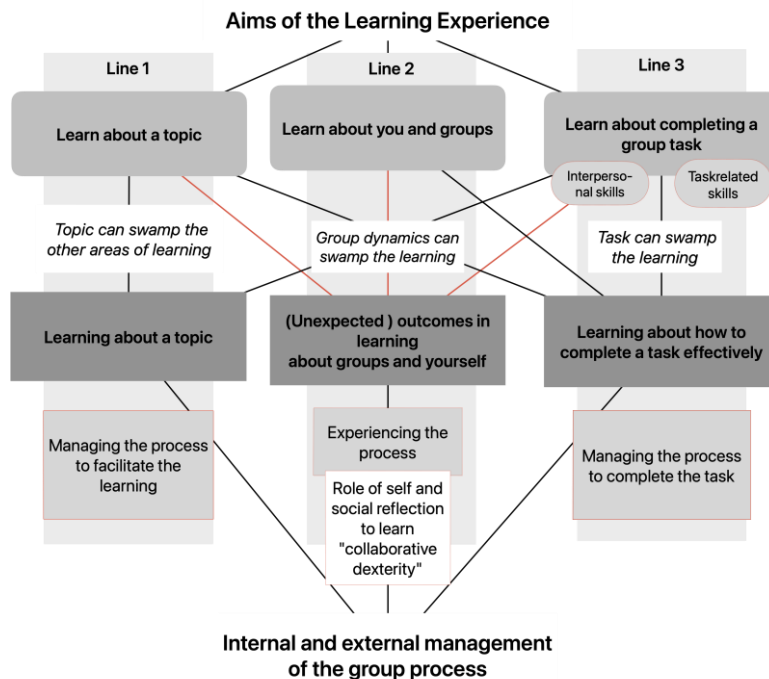

Figure 4: Group-based learning, adaption based on Gregory & Thorley [13]

Line 1 and 3 can be aligned with the proposed instructional aspects of an integrated teaching concept. Furthermore, the line 3 can be aligned with the two-factor theory of the GSQ by splitting the 'task string' into the dimensions of task-related skills and interpersonal skills. This is because both factors emphasize effective group work [12]. In contrast, the line 2, situated in the middle, introduces a novel focus on the role of group dynamics, reflected in individual mindset, and willingness to collaborate. The basic model already integrates these elements into a formal instructional approach, fostering discourse. However, it remains unclear whether this line can be addressed deliberately by an instruction or whether it is of explanatory help.

Another aspect worth considering is the role of reflective processes in addressing individual perceptions of group dynamics. It is distinct from those related to task roles, yet both facilitate metacognitive gains. As reflection of group work situations is important for the skill acquisition, both ongoing self-reflection and social reflection are necessary. Redesigning learning offers must take this into account and address the various mediated learning activities related to group work skills effectively. This also entails deliberately designing reciprocal learning processes that facilitate intentional and conceptually oriented learning and thus foster the development of metacognitive abilities [11]. It leads to a redesigned teaching concept that allows for research into this aspect of individual, experience-based, group-led learning of group work skills.

Nevertheless, it is essential to clarify the specific objective of this line, as the term 'you and groups' is rather vague. The concept of 'collaborative dexterity', describing an individual's disposition and ability to respond quickly to the complex demands of a collaborative process [3], seems to be of value. This concept explicates that individual group work skills extend beyond the topic-specific, task-related, or interpersonal aspects. It explicates the role of individual motivation, the willingness to share ideas, openness to conceptual changes, collective responsiveness, and promotive relationships based on acknowledgment of social interdependence. Collaborative dexterity is linked to an individual's mindset and affects their behavior in groups. Consequently, it may assist in revealing the role of the individual shaping the group in a group-based learning process.

7. Conclusion and Future Work

The initial results show that the experience of group work can be changed by deliberately enriching the subject-based learning process with social skills. This influence is restricted by a necessity to maintain independence and autonomy in the self-study times. It is therefore important to find the right balance between set learning, pre-structured self-study and free self-study [4]. The significance of in-class activi-ties should not be overlooked.

Another aspect that requires further analysis is the relationship between individual attitudes, values, motivations and behavior within a group, on the one hand, and the quality of collaboration and outcomes, on the other. A redesign of socially mediated teaching concepts could enhance the understanding of the metacognitive aspects of collaborative processes.

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