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Impact of Reflection on Individual and Team Performance in Student Team Projects

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Abstract

Higher education is increasingly adopting project-based courses to prepare students for dynamic work environments, yet this approach may overwhelm students and impact motivation and group success. To address this, two undergraduate courses, an undergraduate IT project-based course and an undergraduate material science course, introduced mandatory reflective practices, focusing on self-reflection aligned with Kolb's Learning Cycle. The study aimed to assess if these reflections led to changes in cooperation methods and communication skills, benefiting learning outcomes. Despite initial resistance, students recognized the positive impact on communication and task clarification. While no direct correlation was found between reflection and individual project assessments, a slight connection emerged between improved group time management and higher grades. Additionally, first-year engineering students tended to be overly confident in self-assessment, prompting the need for instructor awareness of student variations for better outcomes in group projects.

Keywords: *inverted classroom, flipped classroom, online teaching, unprepared students.*

1. Introduction

Project-based learning is an educational approach that emphasizes student-centered learning, collaboration, and problem-solving in real-world contexts: Sjølie, Espenes, Buø (2022). It is known for igniting students' intrinsic motivation and promoting profound learning outcomes: Cuseo (1992; Siegeris and Pfennig (2023). Additionally, it enhances interpersonal and interaction skills: Muller (1989) and aligns with the shift towards competency-based education.

As project-based learning gains traction in higher education, there's a need to reevaluate student assessment methods. Self-reflection is suggested as a potential assessment criterion: Bohd, (2015); Goel (2017).

In project-based learning, group processing is crucial for collaborative learning, with team members engaging in critical discussions and self-organized teams: Sjølie, Espenes, Buø (2022); Johnson & Johnson (2009). They continually evaluate their work through team reflection: Kneisel (2020), adjust and improve their workflow, and anticipate adverse consequences: Sjølie, Espenes, Buø (2022; Edmondson (1999). Team reflection is also valuable in online project work, supporting adaptability to online environments: Sjølie, Espenes, Buø, (2022).

High-achieving students use self-reflection for formative and summative purposes, improving their ability to meet teachers' expectations: (Bohd, 2015). Training in reflective strategies has been shown to enhance test performance: (Schneider, 1986). In engineering courses, combining team effort and portfolio assessment provides deeper insights into students' learning (Cress and Cress, 1995). Reflective practices in arts education and reading curricula contribute to individual learning and professional development: (Carpe, 2019). Self-reflection offers detailed feedback but may require additional effort: (Coertjens, 2021).

Despite the potential benefits of self-reflective practices, empirical studies on their impact on academic achievement are limited, especially in project-based group courses. The role of self-reflection in individual student performance needs further research as educators sometimes overlook the student's central role in the learning process.

2. Linking reflection to learning

The levels of reflection encompass a range of depth, with various reflective models, as outlined by Moon (2004) and elaborated by Dowling (2019). It's essential to note that a comprehensive reflection often incorporates elements from these levels. However, to attain a truly "insightful" reflection, it's imperative that the depth of reflection reaches an "analytical" or "concluding" level, as emphasized by Dowling (2019). Kolb's Learning Cycle, as discussed earlier: Siegeris and Pfennig (2023) connects reflective practice to the learning process, where reflection serves as one of the four stages: concrete experience, reflective observation, abstract conceptualization and active experimentation (figure 1).

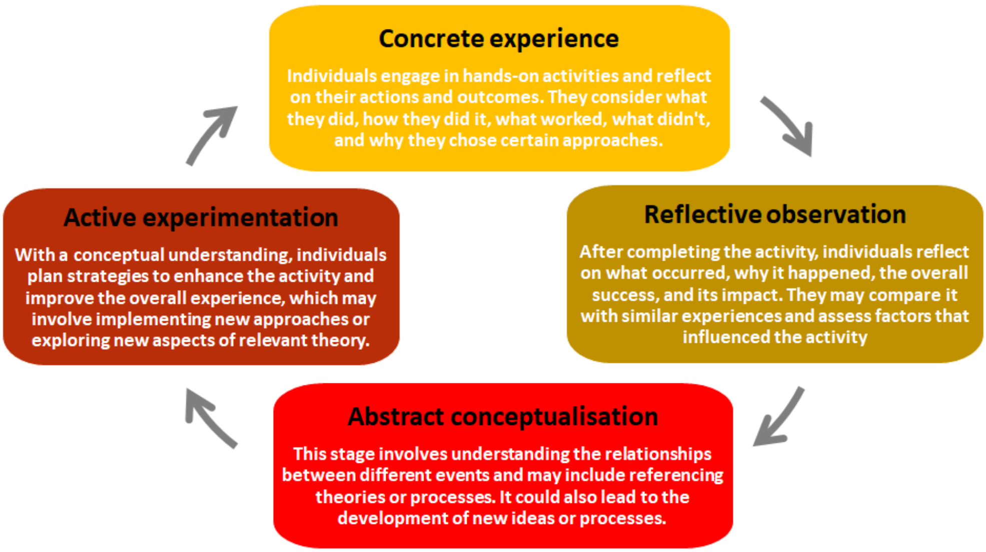

Figure 1: Kolb's Learning Cycle demonstrates four stages in the learning process: A concrete experience is followed by a reflective observation what occurred. After trying to understand what occurred and why, the final step tests the understanding in experimentation. Source: Adapted from Kolb (1984 p. 42) in: Dowling (2019).

In this practical course, the authors investigated whether self-reflection has a positive impact on group performance and the individual learning progress in a project-based course: Siegeris and Pfennig (2023) and will now focus on the impact of reflection on individual student assessment. The authors are specifically focused on Step 4 of the Kolb Reflective Learning Cycle encouraging an ongoing process repeating the 4 steps throughout the project.

3. Reflection as means of improving group performance and individual grades

The reflection cycle is applied in two distinct courses at HTW Berlin: an IT project course and introductory course-level Materials Science course. Both conceptual set-ups and the reflection process have been described earlier: Siegeris and Pfennig (2023). The main difference in learning outcomes are that in the IT project course, the primary objective is to enable students to undertake self-organized projects within teams comprising five to eight students. In the Mechanical Engineering course, students research, develop, write, design, and create educational materials on a topic of their choice within the field covered in an introductory material science course. Groups in this course typically consist of 2 to 3 students. In summary, both courses utilize the reflection cycle, but they differ in their objectives and project structures. The IT project course focuses on practical, real-world applications, while the Materials Science course emphasizes the creation of educational materials within a peer-to-peer learning framework.

Both project courses are demanding and rely on the motivation of individual students and their ability to work effectively in groups. While students have the freedom to choose their projects, fostering successful teamwork in a university context can be challenging. The authors propose a hypothesis: introducing a reflection process that focuses on cooperation, teamwork, and the final product could lead to improvements. Students are required to submit written reflections as part of their project work, with specific prompts provided. This approach aims to enhance collaboration in subsequent phases of teamwork, solve conflicts within the group and improve the project outcome.

1. **Concrete experience:** What is the current cooperation framework, and are there any conflicts?
2. **Reflective observation:** Evaluate your own contributions to the ongoing cooperation.
3. **Abstract conceptualization:** How well does the framework work for you and the team? Reflect on the setting and own contributions to the ongoing cooperation. Reflect on the impact of rules set by the team, cooperation, communication, individual and group performance, the individual micro task as well as individual and group time management
4. **Active experimentation:** Consider possible reactions and suggestions for improvement. What would you do differently next time?

Students submitted their reflections to an impartial person who assured confidentiality. Grading was based on the outcome of the project work, extra credit was given for the reflection. However, a drawback of this method is that the content could not be directly used by supervisors to address conflicts. Instead, students were encouraged to apply their insights to resolve issues.

4. Evaluation

A critical analysis of the method revealed that students faced challenges with the reflection task. They struggled to engage honestly, reflect on their own contributions critically, and encountered difficulties with the writing process. Evaluating the written reflections and their evolution over time, four observations emerged:

1. Problem Description Accuracy: Students often provided vague problem descriptions, using phrases like "communication does not work" or "I just can`t get focussed."
2. Own Contribution: Some students merely listed their tasks without delving into their contribution to the problematic situation or conflict. Most of the engineering students were proud and confident upon their individual performance (Figure 1).
3. Analysis of Conflict Situation: only over time students became more critical of their own contributions. Especially engineering students reported their weaknesses which were mostly related to poor time management and missing reporting to their team member(s).

4. Proposed Solutions: Improving communication, updating task statuses, or starting work on specific tasks from the beginning, assigning micro milestones and meet more often to discuss work in progress were found to be the most desirable learning actions considering group performance.

In both projects in summer semester of 2023, it became apparent that most problems could be traced back to communication challenges. Students found the reflections mostly time consuming and most of them did not directly rate these as beneficial for the project outcome. Later (2nd and 3rd reflection cycle), they recognized its positive impact on communication and task clarification. Due to the nature of the different course settings the project results of the IT course could not be related to any of the reflective statements as too many stakeholders are involved. For the more homogeneous setting of the Materials Science course the main issues addressed in the students` reflections were carefully outlined by lecturers after the course (grading was accomplished) and appointed to weighted numbers (0 (poor) to 10 (outstanding)) based on wording, emotional involvement and rational statements.

First year engineering students tend to be overconfident with their situation in general and their contribution to the team work as they reflect mostly very content on each of the specific promts in their reflection sheets (see above) that have been transferred to the main issues that were illustrated infigure 2. It seems that first year students` evaluation of their overall performance, team behaviour and communications skills strongly deviate from the actual learning outcome. Possible reasons for this overconfidence include limited project work experience, potentially receiving unrealistic praise during high school, or having a generally positive attitude towards scientific teamwork. Lecturers need to be aware that personality and course performance may deviate strongly and students need guidance towards satisfying results in project group work.

Regarding rules, micro tasks, communication, cooperation, and scientific performance as well as individual time management there is no correlation to the individual project assessment (figure 2).

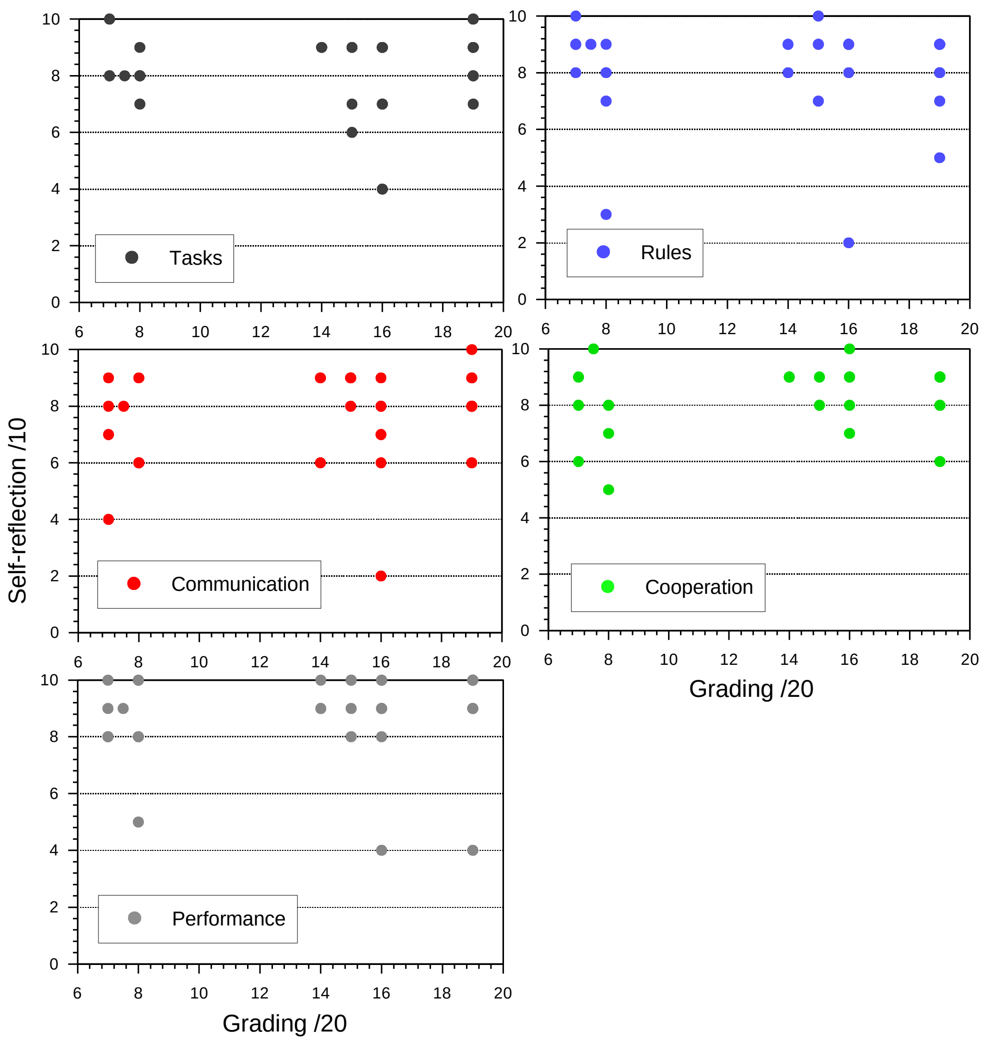

Figure 2. Influence of the individual reflection of students upon tasks, rules, communication, cooperation and individual performance on the project outcome. (0 poor, 10 outstanding)

There is a slight dependence of enhanced group and time management on improved grades (figure 3). Student groups with better time management (deadlines, milestones, informal meetings, etc.) score higher than groups with poor time management. An interesting observation is that even students who believe they are good at time management rate group time management less satisfactorily, leading to the question of why they can't improve group time management despite their individual skills.

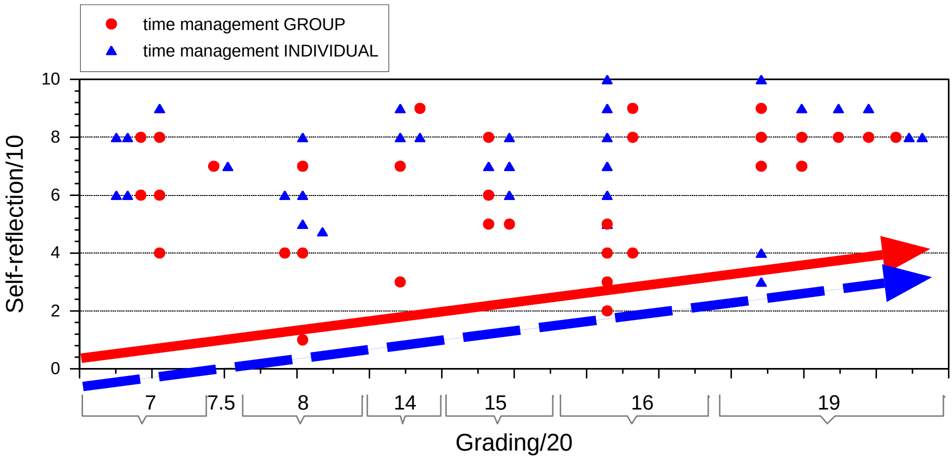

Figure 3. Influence of the individual reflection upon individual and group time management on the project outcome. Students with better group time management scored higher.

4. Conclusion

In two different courses, an undergraduate project-based IT course and an undergraduate first year material science course, reflection cycles were introduced to improve group performance and individual learning. Students' reflections were given extra credit based on critical thinking and self-reflection rather than content or course success. The evaluations were conducted anonymously by the cooperating lecturer. The aim was to understand the impact of reflections on cooperation methods, project outcomes, and whether students found them beneficial for learning. Although students initially viewed the process as extra work, they recognized its positive impact on communication and task clarification. There is no clear correlation between reflection and individual project assessments but a slight link between improved group time management and higher grades, with groups exhibiting better time management skills generally scoring higher.

First-year engineering students tend to be overconfident when assessing their performance and contributions to teamwork, which may not align with their actual learning outcomes. Instructors who gained insights into students' challenges through reflections need to recognize that students' personalities and course performance may vary, and they should consider guiding students to achieve better results in project group work. More management skills and in-person communication will be encouraged in future projects.

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