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# Addressing Collaboration Challenges in Project-Based Learning: The Student's Perspective

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**Abstract:** Project-based learning has been explored in a variety of contexts and different phases of education. Several implementation challenges are associated with project-based learning. Among these challenges is ensuring collaboration between students enrolled in a project assignment. The purpose of this study was to present several practical insights on how to tackle collaboration challenges in project-based learning. The study is based on the qualitative analysis of 67 reflections reports submitted by students who were enrolled in a project-based learning assignment in engineering education. The results suggest that collaboration challenges can be traced to priority conflicts between students as well as to the uncertainty in the project assignment. The results further suggest that these challenges can be successfully addressed by applying a structured project-management approach to planning, communication, and follow up. In addition, the findings suggest this structured approached should be supported by a mindset that recognizes the importance of adaptations and flexibility as the project develops. Moreover, the findings suggest that a collaboration environment based on inclusion, openness, and support enables students to respond to emerging problems and disagreements. The paper outlines several recommendations on how to improve students' collaboration ability within project teams in the context of project-based assignments.

**Keywords:** project-based learning; collaboration; soft skills; project management; project success

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## 1. Introduction

A well-established principle of educational psychology is that telling students that they need certain knowledge and skills someday is not a particularly effective motivator [1–3]. Prince and Felder [4] argued that the motivation and commitment to learning can be enhanced using inductive learning methods to provide contexts for learning. Inductive learning methods have the following two key features in common: First, they are all learner-centered, meaning that they impose more responsibility on students for their own learning. Second, inductive learning methods present new knowledge to the students using contextual situations to which students are able to relate. Inductive learning methods encompass a range of instructional methods, including inquiry-, problem-, project-, and team-based learning; case-based teaching; discovery learning; and just-in-time learning [4].

Project-based learning (PjBL) has gained popularity and has been explored in various contexts and in different phases of schooling, from primary to higher education [5]. The notion of PjBL is to engage students in the investigation of authentic problems where solutions have the potential to be implemented and used in real life [6]. Several benefits are associated with PjBL. For instance, Chen and Yang [7] showed that PjBL, compared to traditional teaching methods, offers the following three unique experiences to students: (1) a sense of freedom to express opinions, ask questions, and engage in discussion with colleagues; (2) the feeling of being able to influence the course of the learning process; and (3) the feeling of doing something that can be applied in practice (as well as contributing to the team's work). Other reported benefits of PjBL include developing metacognitive skills, such as self-regulation, co-regulation, and monitoring [8], as well as supporting self-directed learning [9,10]. Although PjBL has been used for many years in various schools and higher education, some debate is still ongoing in the literature on the conditions that must be met to categorize a teaching method as an instance of PjBL [11]. For instance, Blumenfeld et al. [6] argued that there are the following two essential components of PjBL: (1) a question, which serves to organize and drive learning activities; and (2) a product or an artifact, which represents the outcome of the efforts and activities used to address the driving question. Thomas [8] identified five conditions that must be met to answer the question, "what must a project have in order to be considered an instance of project-based learning?" The five conditions are (1) centrality, (2) a driving question, (3) constructive investigation, (4) autonomy, and (5) authenticity. Thomas [8] explained that centrality means that the project should be the central teaching strategy, not merely an additional or a supporting instructional method. A driving question means that PjBL should be focused on questions or problems that "drive" students to encounter and struggle with the central concepts and principles of the subject. This is usually achieved using an ill-defined problem [12]. Constructive investigation implies that the central activities of the project must involve reflection, conceptualization, and the construction of new knowledge, meaning that if the central activities of the project can be performed with the application of already-learned information or skills, the project is an exercise, not PjBL. Autonomy implies that the project is student-driven to some significant degree. Teaching staff should be involved in an advisory, rather than instructing, role at any or all of the following stages: initiation, planning, implementation, and conclusion [13]. Hell et al. [14] further suggested that autonomy strengthens students' ability to construct new knowledge because autonomy allows students the opportunity to use their prior knowledge and experience, which, in turn, facilitates the construction of new knowledge. The last condition is authenticity, meaning that the project should be realistic, not school-like [15]. Therefore, PjBL should incorporate real-life challenges where the focus is on authentic problems and where solutions have the potential to be implemented.

Helle et al. [14] argued that another key characteristic of PjBL is collaboration, as all participants need to contribute to the shared outcome. Helle et al. [14] further suggested that the strength of PjBL is that it not only enables the integration of knowledge from different disciplines but it also has the ability to bridge theory and practice. In the process of collaboration on project work, students can see and feel the reality to which various concepts and interactions are related, which serves to facilitate conceptual change and to build mental models enriched with experiential knowledge.

Building shared mental models enriched with experiential knowledge within the context of project-based learning occurs when learners are provided the opportunity to experiment, reflect, and accumulate knowledge while engaged in project activities [16], p. 48. PjBL is primarily a learning-by-doing approach and is a part of the experiential type of learning [17]. Experiential learning was defined by Kolb [18] as the process whereby knowledge is created through the transformation of experience.

Kolb's experiential learning cycle has become a well-accepted model to explain the role of reflection on experience in learning, as shown in Figure 1. Kolb's model demonstrates that experiencing something alone is not enough to ensure learning. If individuals want to learn from experience, they have to purposefully reflect on these experiences [19]. Therefore, self- and group-reflection is needed to conceptualize such experiences as insights. Only then can the new insights be applied and tested in new situations, which, in turn, will lead to new experiences and, ideally, the cycle will be repeated.

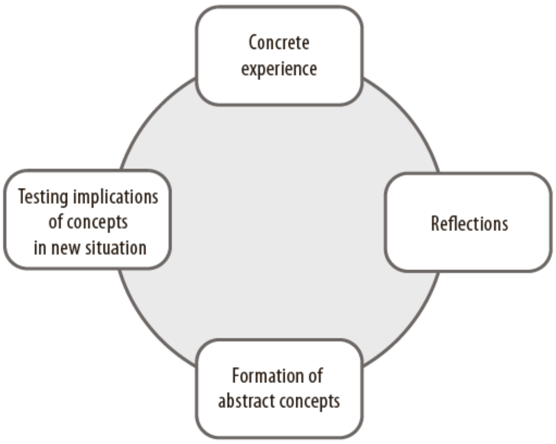


**Figure 1.** Experiential learning (Kolb 1984, p. 21).

### 1.1. Impact of PjBL

The extant research evaluating the impact of PjBL is diverse and examines PjBL from both academic and non-academic viewpoints [11]. For instance, LaForce et al. [20] suggested that PjBL has a positive impact on several dimensions such as attitudes and interest in a future career in the subject matter. Turner and Mulholland [21] stated that PjBL can lead to improving creative thinking and developing soft communication skills. Herbe et al. [22] showed that PjBL improved the students' engineering judgment, and demonstrated to students the value of engineering analysis and mathematical models in practical engineering design. Lasserre [23] presented a case in which the application of problem-solving using PjBL reduced the number of students dropping out from a programming course. Mantawy et al. [24] showed that PjBL can be used to bridge the gap between academia and practice. Another example was provided by Shen et al. [25], who demonstrated that using PjBL with BIM tools coupled with energy analysis software can effectively teach energy-efficient building design and construction to engineering students. Rambocas and Sastry [26] provided empirical evidence that the introduction of PjBL improved students' experiences and increased their interest in the learning processes in which they participated.

From an academic viewpoint, the impact of PjBL is inconclusive [7]. Some evidence suggests that PjBL has a positive impact on learning. For instance, Boaler [27] found that students who learned mathematics in a project-based environment developed a conceptual understanding that provided them with advantages in a range of assessments and situations. Schneider et al. [28] showed that students participating in a project-based curriculum were better prepared for the National Assessment of Educational Progress (NAEP) science test compared to other students who experienced traditional classroom teaching. Ngereja et al. [29] and Hussein et al. [30] reported that using PjBL contributed to increased understanding of the practical challenges and problems encountered in managing digitalization projects. Karaçalli and Korur [31] analyzed the effects of project-based learning on students' academic achievement, attitude, and retention of knowledge using a quasi-experimental method involving a test group and a control group. They concluded that the academic achievement and retention of knowledge of project-based learning groups were better than those of a traditional teaching group. Hussein et al. [32] showed that PjBL can be used for the co-creation of teaching and learning materials. Bovill et al. [33] explained that the co-creation of learning and teaching occurs when staff and students work collaboratively with one another to create components of curricula and/or pedagogical approaches. In another study, Ralph [34] reviewed fourteen studies on PjBL in STEM education, finding that PjBL increased the development of both learners' knowledge and skills.

The lack of strong evidence of the impact of PjBL on academic achievement was demonstrated by Helle et al. [14]. They showed that there are relatively few studies that actually report on the assessment and evaluation of PjBL. They found that most of the published scholarly articles on PjBL are descriptive in nature and do not provide any evaluation of the impact of the method on learning. Of 28 research articles they reviewed, only two provided objective evidence on learning outcomes. Guo et al. [35] suggested that it is difficult to determine the effects of PjBL on student learning as most of the studies they analyzed did not implement research designs that allow claims about the effects on learning outcomes.

Some other scholars challenged the effectiveness of PjBL compared to other traditional methods. For example, Markham et al. [10] indicated that the effect of PjBL on improving academic achievement is only equivalent to or slightly better than other teaching methods, and the empirical data are insufficient to state that PjBL is a proven alternative to other methods. Powell and Wimmer [36] found that students positively evaluated their perceived learning of group project implementation on their experience of the learning process, but found no strong evidence to suggest that working in groups had any impact on learning. Panasan and Nuangchalerm [37], who compared PjBL and inquiry-based learning (InBL), found no significance difference between the two methods on learning achievement, science process skills, or analytical thinking.

### *1.2. Implementation Challenges of PjBL*

As we indicated in the Introduction, building and designing authentic products that have the potential to be implemented in real life are a cornerstone requirement of PjBL. There have been several attempts to identify the challenges encountered by, e.g., instructors and students, to fulfill this requirement of PjBL [38]. Other attempts have been made to suggest recommendations for the successful adoption of PjBL. For example, Kokotsaki et al. [5] emphasized the importance of student self-management and effective group work through sharing equal levels of agency and participation. In addition, student autonomy is needed throughout the PjBL process to help students develop a sense of ownership and control over their learning. Drain [39] suggested an approach based on organizing PjBL in two phases to help the students become sufficiently competent, by developing the knowledge and skills needed in the first phase, then to be able to design and create products independently in the second phase. Krajcik et al. [40] examined the challenges encountered by students during building products and artifacts within the context of PjBL, and found that although students showed the ability to generate plans for conducting the activities, they often failed to implement their plans systematically. The authors concluded that students need multiple supports as they conduct their inquiry to be able to systematically develop and realize their plans. Hallermann et al. [41] noted that achieving the successful implementation and conclusion of PjBL is dependent on several conditions, including the organization of students groups who will complete the project. Tseng et al. [42] and Miller and Hadwin [43] indicated that the mere designation of groups does not guarantee effective cooperation and the implementation of PjBL. They affirmed that student groups have to develop their own framework of how collaboration will be actually realized to plan and execute their project activities. Edelson et al. [44] showed that a successful implementation of PjBL requires students to organize and collaborate to manage complex, extended activities. This includes the planning and coordination of activities and the management of resources and work products. Pucher and Lehner [45] suggested that due to a lack of experience in project management, PjBL students frequently encounter problems due to a failure to identify and manage the various risks associated with PjBL. Mitchell and Rogers [46] demonstrated that confidence is a key feature of staff engaged in delivering PjBL activities, in particular, confidence in accepting the role as a collaborator in the learning process rather than as a figure of authority or knowledge.

The view that considers student collaboration as both a learning outcome and an instructional strategy led researchers to investigate not only how collaboration may increase learning outcomes but also how collaboration can be improved—learning to collaborate [47]. For this reason, Notari et al. [48] examined the social skills that should be taught to students to support collaboration. These social skills include consensual decision-making skills, dialogue and discussion skills, conflict resolution skills, and team leadership skills. Although the importance of social skills, communication skills, proper organization, planning, and the systematic execution of project activities have been emphasized by several studies, the current body of knowledge on PjBL does not offer a detailed account of how students themselves experience or address these challenges to ensure the successful implementation of PjBL.

Instructing students to plan, organize themselves, or collaborate without offering the students an outlook on how to achieve these conditions might not lead to the desired outcome. In this study, we aimed to fill in this gap by identifying the measures needed to ensure proper collaboration in the project-based learning context. To identify these conditions, we drew on the experiences gained from conducting a project-based learning assignment that was offered to engineering students at our university in a project management course at the master's level. The course is offered as a part of the European Master's Program in Project Management (EUROMPM). The program is an established method of competence delivery in project management, both for graduate students and professionals [49]. An overview of the other instructional methods used in this introductory course can be reviewed in [50]. This study was, therefore, guided by the following research questions:

- What are the underlying causes of the collaboration challenges in project-based learning context from the students' perspective?
- What are the enablers to collaboration in the context of project-based learning?
- How can we understand these enablers using the existing body of knowledge on project management?

The results of this study present an account of the typical challenges encountered by student groups during a project-based assignment. The findings further suggest a framework for responding to these challenges from the students' perspectives. We used project management literature to discuss both the meaning and significance of these approaches. The results of this study should help instructors and students involved in PjBL in engineering education to better prepare for and commit to the project tasks and activities.

The rest of the paper is organized as follows: First, we start with a description of the project-based assignment that was offered to the engineering students in a project management course at the master's level. We then present the data collection method used to gather student experiences and the lessons learned. In the Findings section, we present detailed account of these lessons learned, recommendations, and the impact of these lessons learned on organizing, planning, and executing project assignments. In the Discussion, we compare the findings with the existing body of knowledge; in particular, we draw on the body of knowledge of project management to demonstrate the importance or the impact of these recommendations. Finally, in the Conclusions, we present a list of recommended best practices to implement project-based learning and we highlight the implications of project-based learning in higher education.

## 2. Method

In this section, we provide a full description of the project assignment and the data collection method employed in this study.

### *2.1. Description of the Project-Based Assignment: The Digitalization Project*

The project assignment outlined in this paper was developed to offer engineering students attending an introductory course in project management a thorough understanding of the challenges of managing digitalization projects, and to gain insights into how to address these challenges [29]. In the management literature, digitalization is broadly defined as using digital technology to create entirely new products, processes, or systems [51]. Digitalization projects are, thus, far more unpredictable, iterative, and experimental [52]. The challenges of managing digitalization projects are rooted in the interplay of the following three dimensions [30]: (1) managing the collaboration between diverse individuals or organizational units to achieve project objectives; (2) managing the value creation process in order to create novel processes, products, or services that create value for the end users; and (3) managing the procurement and implementation of the digital enablers or digital technologies to create the intended novel solutions. The three dimensions, therefore, constitute the main pillars of managing digitalization projects, as shown in Figure 2.


**Figure 2.** Pillars of managing digitalization projects.

Due to the complex interplay between the three dimensions of digitalization projects, lecturing on the challenges of managing digitalization projects might, therefore, not be the best approach to convey the complexity of this type of project. Students need to experience the challenges, and suggest and implement solutions to these challenges by themselves in order to be able to gain deeper insights and the competences needed to manage this type of project. The project assignment was, therefore, designed to provide the students an opportunity to:

- Develop an understanding of the conditions needed to manage digitalization projects effectively;
- Develop insights into the challenges associated with managing digitalization projects;
- Enable students to realize that managing digitalization projects requires attention to the interrelationship between managing collaboration, value creation, and the digital-enablers.

As the students enrolled in the program belonged to different disciplines of engineering education, such as production engineering and information systems design, it was, therefore, important to design a suitable assignment where students from different disciplines could draw on each other's strengths. In addition, the assignment was designed to adhere to the following rules [53]:

- The project is non-trivial and requires multi-disciplinary work over an extended period of time;
- The project involves the development of an actual product;
- The culmination of the project is a written report describing and evaluating the final product;
- Teaching staff assume an advisory rather than an authoritarian role.

The task assigned to students, therefore, included the following three requirements:

1. Students were instructed to organize themselves in self-enrolled groups of 4–8 students and to jointly determine how they should select, plan, develop, and produce a digital learning aid to support learning in project management. The choice of the

type and form of the digital learning aid was left to the students. Examples of these digital learning aids include but are not limited to the following:

- Producing an animation of a real-world project case, explaining the main events, the challenges encountered, and useful insights gained from the real-life case.
- A computer simulation that shows how certain project variables such as risks, cost, and time are influenced by each other and the dynamics of their interaction.
- A gamified experience of a problem or a project situation using computer games.
- Gamified tests and quizzes to support leaning.

2. The final product produced was required to have a significant impact on learning. The students were further instructed to plan and document how they verified that the final product has a significant impact on learning.
3. The final product had to be implemented on a digital medium, such as a computer, tablet, or cell phone, and not to use any other analogue medium.

### *2.2. Project Stages*

The project assignment was designed to include various deliverables at various stages of product development. The assignment was executed in six stages following a typical stage gate model, as shown in Figure 3. Although the overall assignment was conducted using a stage-gate model, the work on each stage was based on incremental or adaptive approach because of the nature of the tasks the students were completing.

(1) The initiation stage included a brief introduction to the concept of digitalization projects through some real-world cases. This phase included providing students opportunities to revisit the literature on digitalization projects to familiarize themselves with the terms and concepts. Project groups were also established in this phase. Some students established the group based on previous acquaintance with each other. In some other groups, students have used the learning management system to recruit students to their group. The relationship between the students and the course instructor was mainly based on an advisory role to solve issues related to the formation of student groups.

(2) In the second stage, the planning stage, the students were instructed to develop and submit a detailed project plan. The work plans included a description of the intended product, the tasks and activities to deliver their product, the selection of project execution strategies to develop the product, a milestone plan of the intended development process, identification of stakeholders, identification of risks, and a time schedule for conducting the project activities. This work plan was then reviewed and commented on by the course instructors.

(3) In the third stage, the execution stage, tasks included working on developing and testing the final product and ensuring that the project creates value for the learners.

(4) Product delivery was the stage where the students conducted final checks and uploaded their final products on the chosen medium.

(5) The fifth stage was the peer assessment stage, where each group was assigned a product developed by another group, and the task was to review and assess the quality of the final product produced by the assigned group.

(6) The documentation stage included tasks such as writing a reflection report by each student group. A template that contained several questions that students were asked to answer was developed and provided to guide students in report writing. The reflection report template contained the following four sections:

   a. Description of the final product.
   b. Evaluation of the impact of the product on learning.
   c. Students' own reflections on factors that contributed to the success/failure of their project.

d. Reflections on the most important lessons learned from conducting the assignment, in particular, for each of the three pillars of managing digitalization projects.

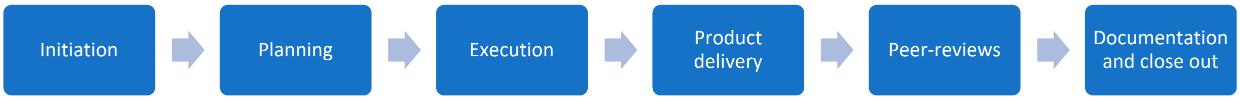


**Figure 3.** Project stages.

### 2.3. Data Analysis

The findings presented in this paper are based on qualitative thematic analysis. For this purpose, we used the written reflection reports submitted by each student group upon completing the project. Altogether, 67 project reports were produced and submitted by the student groups. Benbasat et al. [54] suggested that the qualitative approach is particularly useful when the researcher seeks to gain new insights due a lack of previous studies. According to Glaser and Strauss [55], qualitative analysis does not aim to identify associations in the data but rather attempts to identify common concerns or common patterns in a large data set. From this perspective, emphasis was placed on understanding the students' experiences with collaboration in project-based learning. The hope was that the analysis of the students' experiences would contribute to new understandings of how students, with different backgrounds and experiences, perceive and address the collaboration challenges in PjBL. This was achieved by searching for common concerns or patterns (themes) in the reflections reports written by the students [56]. This iterative process of reading and analysis was guided by the phases recommended by Braun and Clarke [57]. According to Braun and Clarke [57], a theme captures something important about the data in relation to the research question, and represents a pattern or a meaning within the data set. Furthermore, they suggested that the importance of a theme is not necessarily dependent on quantifiable measures, but rather on whether it captures something important in relation to the overall research question. There are the following two primary methods in thematic analysis: an inductive or bottom-up approach [58], and a deductive or top-down approach [59]. A top-down, or theoretical-driven, approach uses a theoretical framework to interpret the data. Conversely, the bottom-up approach uses the data to identify patterns and meaning. As the thematic analysis in this study is not linked to a particular theoretical framework, it was natural to follow an inductive thematic analysis for each of our research questions. The first phase of data analysis involved uploading and reading each report in the Nvivo software package to allow for familiarization with the data. Each report was uploaded as a single data set. In the second phase, after reading each report, excerpts from each report were extracted and assigned new codes. Excerpts that had similar meanings were assigned to the same code. In the third phase, codes were grouped into possible themes. For instance, a theme that emerged from reading the reports was that several groups talked about the challenge of having students from multiple departments with different interests and priorities working together on an assignment. This, according to several reports, was a demanding situation that had to be addressed during the assignment.

## 3. Results

### 3.1. Reasons for Collaboration Challenges

From the reflection reports, collaboration challenges could be grouped into three root causes, as illustrated in Figure 4.


**Figure 4.** Root causes of collaboration challenges.

#### 3.1.1. Schedules

Firstly, over 200 students were enrolled in the course. These students belonged to different faculties and different study programs at the university. Therefore, they had different time schedules and other commitments, and they did not necessarily share the same time schedule. The following quotations from student reports highlight these experiences:

> *"One of our main preoccupations when looking at the project realization was the incompatible team member schedules."*

> *"All the members of the group have at least three other subjects to work with beside this course. Like this course, the others also have different submissions that have to be handed in before a deadline."*

#### 3.1.2. Priorities

In addition, many students had voluntary assignments and extracurricular activities that required their time and attention. Due to these commitments, it was difficult for many students to prioritize the tasks of the project assignments when their contributions were needed.

> *"Some group members had voluntarily work and therefore this was sometimes prioritized above the project work sessions."*

#### 3.1.3. Uncertainty

In addition, the reflection reports showed that the collaboration challenges could be traced back to the uncertainty of the project assignment. The project was based on a broad goal to produce a digital learning aid that should have a significant impact on learning. The reflection reports suggested that three main areas of uncertainties were found in the assignment. These areas of uncertainty are shown in Figure 5.

(1) Product uncertainty: Uncertainty related to the type of digital solution that should be used to achieve the objective given the available skills, schedule, and knowledge.

> *"One of the main challenges the group experienced with this type of project was that the group first decided to make an animation of a case, but later on, had a change of mind. The group discussed a lot back and forth, and it was difficult coming to a conclusion on what type of project to go for."*

(2) Uncertainty of the process that should be followed to deliver the final product. This included how the group should organize itself, and how students should use the skills and knowledge of each individual in the group to achieve their goals.

> *"The project management of this assignment was a bit chaotic on our part."*

Uncertainty of the process was further complicated due to the lack of necessary ICT skills, in particular, the skills required for the students to realize the vision of their product.

*"Lack of sufficient competence on how to make animations was the biggest obstacle regarding project completion."*

(3) Uncertainty about the product's ability to improve learning or have any impact on learning.

*"The first challenge was to get an idea of what the possible options are for a feasible digital learning aid that creates a significant impact on learning."*

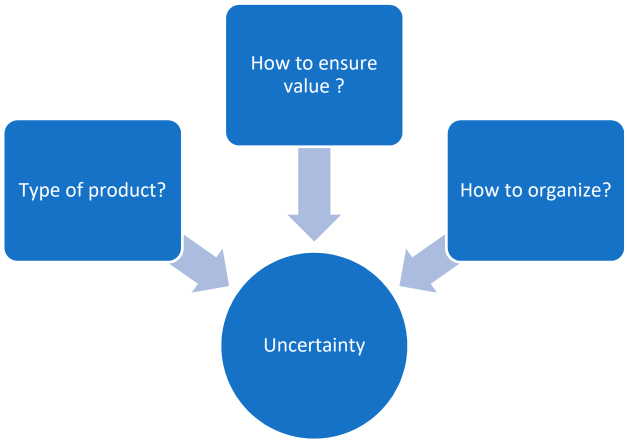


**Figure 5.** Aspects of uncertainty in the project assignment.

These uncertainties created multiple opinions and provided a rich ground for discussions that many students groups had to handle.

*"The group spent a long time discussing ideas about the project and, while doing so, it was difficult to understand and accept each other's opinions."*

Multiple and diverse ideas emerged on how to proceed with the project or on how to ensure an impact on learning to address each uncertainty. It was, therefore, difficult for every group to identify a shared concept that was feasible, acceptable by all, and executable within the time allowed, also considering that students had different priorities and different time schedules. Ensuring collaboration, therefore, required balancing multiple opinions and approaches in an uncertain context. The impact of these uncertainties can be highlighted by the following quotation from the student reports:

*"For our project, the main challenge was to get to grips with the tools needed to help bring life to our vision. For a short amount of time, we were at a loss of how to achieve the goal."*

### *3.2. Addressing the Collaboration Challenges*

The reflection reports submitted by students included several reflections on how the groups succeeded or failed to address the root causes of the collaboration challenges during the project's execution. The findings suggest that the collaboration challenges during the assignment were addressed using the following five principles:

A. Structuring knowledge and information sharing within the group;
B. Investing time in the early project phase to organize and identify tasks;
C. A structured approach to project follow-up and obtaining feedback from stakeholders;
D. A mindset that prompted accepting changes to scope or goals underway;
E. Focusing on having a good working environment based on inclusion, mutual support, respect, and openness within the group.

In the following, we highlight each of the above five principles using quotations from the reflection reports.

#### 3.2.1. Structure Information Sharing

It emerged from the reflection reports that a critical success factor that enabled the groups to improve collaboration was establishing a visible structure for internal communication within the groups. This included establishing routines for face-to-face meetings, and using these face-to-face meetings to clarify important topics regarding the project during these meetings.

> *"During an eye-to-eye discussion, things are suddenly way easier."*

In addition, communication was organized using various ICT tools or chat apps to ensure timely communication and the regular update of project members. This visible structure also helped to capture problems as they emerged and evolved. Additionally, this allowed the groups to hold meetings with short notice. These tools allowed students to talk directly and allowed everyone to read what other teammates discussed. This resulted in everyone showing up to meetings well-informed on the latest agreements.

> *"ICT platforms were also used for following up on progress after the weekly meetings. The use of the digital collaboration platform further established clear roles and responsibilities, which was one of the other important success factors."*

#### 3.2.2. Invest Time in the Early Phase

Another important lesson learned identified by the groups was the criticality of adequate planning during the early phase of the project. The findings suggest that successful collaboration required initially investing adequate time to create a shared understanding of the product's capabilities and limitations. Although this shared understanding was developed further or changed during the execution, the reflection reports suggested that this initial understanding created a common vision for the next activities.

> *"It is important not to rush this decision, but take the time to figure out and identify the learning objectives of your final product before deciding on the type of product."*

> *"We successfully avoided priority confliction by early planning. At this stage, we spent plenty of time to discuss the capabilities and available time we have to guarantee that all the group members could be assigned the proper tasks. As a result, every group member was loyal to the assignment during the implementation."*

In addition, up-front planning helped the students to avoid potential misunderstandings and to decide how much time each team member should commit during the project. This was an important step, as suggested by many student groups, to reduce the risks of having multiple time schedules or conflicting priorities. This, according to the reflection reports, increased the loyalty and commitment to the shared vision of the assignment during the implementation.

> *"Make sure the entire group shares the same goal and vision of the project. If the entire group knows what they want to accomplish and what end product the group aspires toward, it is much easier to motivate the team members."*

> *"Early on in the project, the team agreed to meet at a set time each week. It also ensured predictability for the times that the team members worked individually."*

It emerged from the reflections reports that early planning was used to discuss and agree upon the following tasks:

- Identifying the roles and responsibilities of each group member;
- Identifying tasks, dependencies between tasks, and the duration of each task;
- To identify risks and mitigation plans.

#### 3.2.3. Structured Approach to Project Follow-Up and Obtaining Feedback from StakeHolders

A structured approach to organizing follow-up meetings to check progress regularly and compare it to the plan or to make decisions regarding the required changes or adaptations was highlighted as an important factor that helped collaboration within the teams.

> *"Scheduled meetings were held every week during the entire project duration. This helped the project team to keep track of the project progress and its members' progress related to their assigned responsibilities."*

The insights gained from the reflection reports suggested that a contributing factor that enabled collaboration was to have every member to dedicate a certain number of hours to work on the project. Early on, many project teams agreed to meet at a certain hour each week. This also ensured predictability for the times that the team members worked individually.

> *"We respected all the deadlines imposed by ourselves, and the little changes that appeared in our project were easily solved thanks to our good communication and good time management."*

> *"The deadline was also a big concern, but, as previously mentioned, through the establishment of checkpoints and weekly meetings, we managed to finish the final product within the established deadline."*

#### 3.2.4. Developing a Mindset to Prompt Accepting Changes to Scope or Goals Underway

Although developing plans, defining roles and responsibilities, and structuring communication were mentioned as key lessons learned, the findings from student responses suggest that it was equally important to accept and acknowledge that pre-defined plans were subject to changes. Several student groups suggested that accepting that plans could be adapted and changed mid-process not only reduced collaboration challenges but led to improvements in the abilities of the final product.

> *"We were aware of our own limitations and prepared to adapt features especially if it's the first time you did this kind of job."*

> *"Our advice is not to get to stuck in one lane, and always focus on developing the product for the better. Changes will, in most cases, lead to an improvement in the product, rather than an aggravation."*

Flexibility was highlighted as an important success factor not only to address the various uncertainties of the project but also to mitigate the risks associated with having students from multiple departments with different schedules and to address the risk of dropping the subject after enrollment.

> *"So, advice that we can give to other students is that sometimes it's okay to change the project schedule during the development of the project if you think it will result in a better final product."*

#### 3.2.5. Prompt Openness and Support

The findings suggest that successful collaboration required having a group culture of openness during the creative process. This included fostering the acceptance of new ideas, asking for help, and sharing thoughts within the group.

> *"Even though everyone had their own tasks, we tried to help each other out when we needed help and made sure we knew the status of the project."*

> *"We had a good working environment where every individual had the opportunity to state their opinion that always was respected and appreciated."*

To create a positive working environment within the team, several groups suggested to initiate several activities such as having dinner together, meeting for coffee, going on a cabin trip, and even holding a cook-off competition. These activities helped the teams to grow and bond together.

> *"We got to know each other better and became friends along the way. This helped the project immensely, in terms of working together and helping each other out, to create the best possible outcome."*

*"Regarding the ground rules for communication, all members had the same in mind: everyone can share their thoughts, everyone is being heard, there are no bad ideas or contributions, everyone is being treated respectfully and no one is being left out."*

This mindset resulted in more harmonious team meetings with less conflicts or arguments. In addition, everyone's ideas were highly appreciated and were further elaborated in objective discussions. The students also spent some time during these meetings to help and teach each other some skills that were lacking by some group members.

*"A lot of time was spent on teaching and helping each other so that we all understood the entirety of the code. We wanted to make sure we all got the most out of it."*

## 4. Discussion

In this section, we discuss the significance of the findings from this study using the extant project management literature and highlight the contributions of this study regarding collaboration in the context of project-based learning.

The findings highlight the following five main enablers of collaboration, as suggested by the student reports:

1. Establishing information sharing and a communication structure to facilitate the organization of meetings and document sharing during the project;
2. Adequate plans that describe tasks, roles and responsibilities, risks and mitigation plans, resource usage, and schedules;
3. Establishing a structure for project follow-up and monitoring, including plans for the evaluation of progress and the time needed for these meetings;
4. Establishing a project culture based on respect of other opinions, mutual trust, openness, and inclusion;
5. Promoting a mindset that recognizes that changes and adaptations are inevitable in the context of project-based learning. This implies accepting that plans are subject to change, that decisions can be put on hold, and even objectives and success criteria can be changed.

An illustrative diagram of these enablers of collaboration is shown in Figure 6.

In the project management and the project-based learning literature, a wealth of evidence suggests that planning, structuring an information flow, and the identification of risks are important prerequisites of success in project-based environments [60,61]. The purpose of planning these activities is mainly to integrate what the project team members know and are able to do, and formalize this knowledge into plans, check lists, and formal documents. Bond-Barnard et al. [62] argued that a positive relationship exists between collaboration and this formal process of knowledge integration. It is evident from revising the reflection reports that establishing the correct structure for information sharing, communication, a clear division of tasks, a clear division of roles and responsibilities, the identification of risks, the identification of meeting times, etc., enabled the project teams to overcome or mitigate some collaboration challenges. In particular, developing a robust structure for the project contributed to reducing the impact of the following main collaboration challenges:

- Priorities;
- Schedules;
- Process and product uncertainty.

This robust structure created an understanding of the mutual relationship between the various team members, which, according to Pinto [63], is a cornerstone in building a collaborative team. The evidence from the reflection reports suggests that having this clear structure considerably contributed to understanding that this mutual relationship between the students involved and, hence, enabled this mindset of collaboration.

Having an adequate project structure contributed to reducing uncertainty about the expected efforts from each team member and improved the level of dedication from each member in the group. Therefore, we suggest that a positive relationship exists between establishing a clear and visible project structure and collaboration. Planning tools such as time schedules, work breakdown structure, and resource loading charts can help to create this mutual understanding and facilitate communication within project teams. It was also suggested that planning must be viewed in conjunction with various follow-up and control processes. The purpose of these control processes is, for example, to monitor and adjust project plans if needed [63]. It is also important to stress in this regard that how much structuring should be organized up-front during the planning phase needs further investigation.

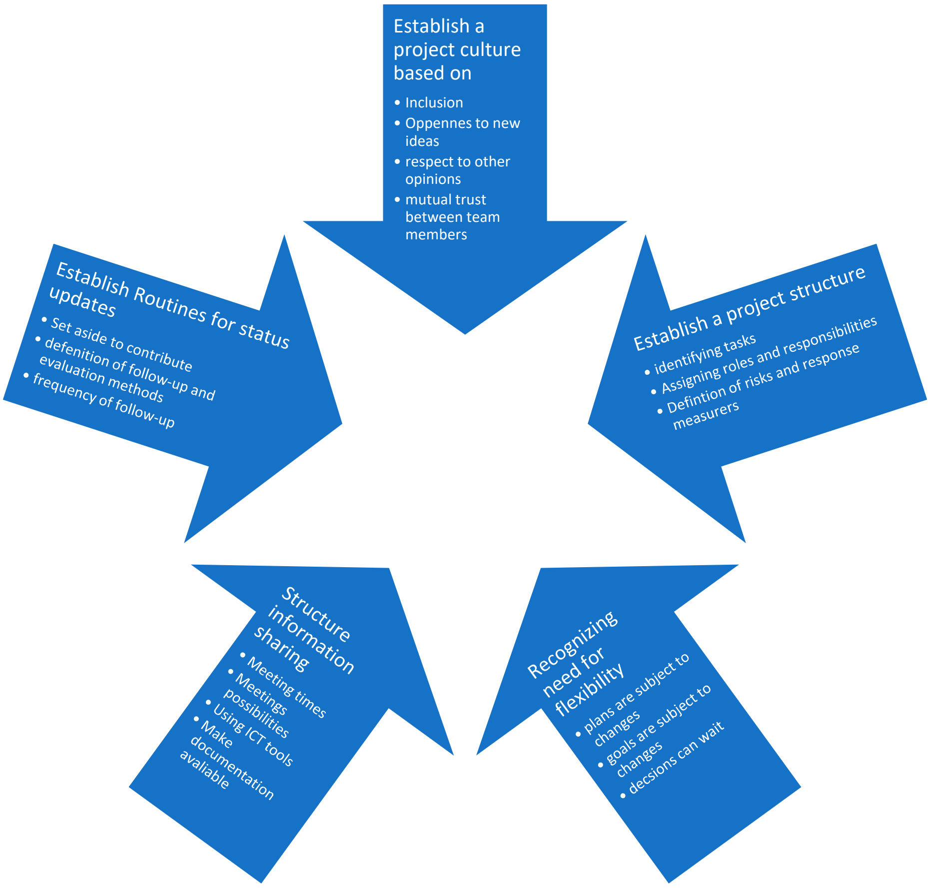


**Figure 6.** Enablers of collaboration.

In the project management literature, this subject is still a debated topic because of the uncertainty about project context. For example, it was suggested that planning should be performed progressively [64]. Opponents of project planning argued that detailed planning can restrict or reduce creativity. For example, Chatzoglou and Macaulay [65] stated that project planning does not guarantee that all requirements will be met. Therefore, effective planning requires a mindset of flexibility to cope with the unique tasks that the members of the team will perform. The flexibility can be achieved using different approaches, such as the use of time reserves or alternative plans, adapting goals, postponing decisions, using iterative planning methods, or simply accepting that plans and objectives are prone to changes [66,67]. Flexibility can also be achieved using agile approaches through small deliveries to reduce a project's vulnerability to changes [68,69]. The ability to handle emerging issues is another dimension of flexibility, especially when the project teams does not have the opportunity to predict all the possible challenges in advance [70]. In this situation, decision-making requires critical and analytical judgment, and is based on facts and experiences.

We, therefore, suggest that project-based learning provides opportunities for students to develop this type of managerial skill. Recognizing that objectives, schedules, and plans are all subject to changes in any project environment reduces tensions in the project teams when they are faced with the inevitable fact that their ideas, plans, or schedules do not match the ambition level of their project or that they have to be changed or adapted to respond to emerging problems or changing contexts. The evidence from the reports suggests that having a mindset that recognizes the importance of flexibility contributed to handling the following challenge:

- Process and goal uncertainty

This mindset of flexibility can be further enforced by providing the project teams with a higher degree of autonomy to ensure that they can themselves choose what to prioritize and how to respond to changes in scope as they see fit. Autonomy is a sense of freedom and independence in one's work. It is an important factor in creating what organizational theorists call intellectual stimulation [71]. Autonomy is also important for maintaining motivation and knowledge sharing in teams.

The findings from this study highlight the importance of soft skills, in particular, supporting each other and learning to see and accept others' viewpoints. These factors were repeatedly mentioned in the student reflection reports. This set of factors was highlighted by many groups as an important condition to reduce potential misunderstandings, reduce conflict, build trust, and sustain commitment to the project. In particular, recognizing the importance of listening and accepting others' viewpoints enabled the project teams to implement corrective actions to achieve the objectives or assigned tasks when needed. The terms "hard" and "soft" skills are loosely and ambiguously used in the PM context [72]. Soft skills, or people skills, refer to dealing with human issues, whereas hard skills generally refer to processes, procedures, tools, and techniques. The realization of the importance of soft skills is increasing, and some project management standards highlight the importance of people, as they are the ones managing projects and performing the work, directly influencing the project's outcomes [73].

The importance of soft factors within the context in project-based practices has been widely discussed. The term soft factors is usually used in the project management literature to denote factors that describe behavioral aspects and people's attitudes [74]. Understanding the impact and the significance of soft factors in managing projects is receiving increasing attention in the project management literature. For instance, Purna Sudhakar et al. [75] demonstrated that soft factors such as team climate, team diversity, team innovation, team member competencies, top management support, and team leader behavior affect software development team performance. Hussein and Hafseld [76] showed that the success of governmental information systems projects requires encouraging end users to speak their opinions freely and to avoid conformity. Deep et al. [77] found that the following three soft factors play a critical role in enabling collaboration: trust, commitment, and the reliability of decisions. Ghazinejad et al. [78] examined the impact of openness in project-based organizations and suggested that openness between team members is a key factor in promoting and encouraging the building of trust. Trust strongly influences decision-making processes because decisions are made on the basis of both trust and the perception of a risk situation [78]. In addition, trust reduces the need for control. In the project-based learning context, Notari et al. [48] suggested that collaboration among students can be greatly enhanced by strengthening their ability to see and accept others' viewpoints. Being open about others' viewpoints facilitates the alignment of expectations and helps team members to achieve a common and mutual understanding of the project scope [79]. Openness also helps to improve the relationship between team members and fosters commitment to deadlines. Collaboration is also enhanced by strengthening students' ability to help each other to gain the knowledge or skills required to complete the task. The findings of this study suggest that maintaining dedication to the project was achieved by the involvement of the project team members in selecting and adapting their tasks. We, therefore, argue that a mindset of flexibility greatly improves the dedication to project goals and objectives. The findings from the student reports point to the several advantages of openness, support, and inclusion to maintain the unity of the group when the project execution is challenged.

## 5. Conclusions

Based on the findings and the discussion outlined in the previous sections, we suggest that the implementation of project-based learning requires students' attention to the following two important dimensions that influence each other:

- Establishing an adequate project management structure (structural dimension);
- Recognizing that students directly affect the project outcome (people dimension).

Having an adequate project management structure to organize and clarify expectations and tasks helps to establish routines for information flow and for status-following, understanding known challenges, and integrating their knowledge, which, therefore, helps students to understand the mutual dependencies between their tasks. This structure also positively contributes to clarifying expectations and increasing the dedication of each member in the group. The second dimension is the people dimension, in particular, how the team members view and interact with each other in the project. The evidence suggests that a mindset based on understanding each other's roles, supporting each other when needed, and openness to new insights and ideas are critically important factors in maintaining a collaborative environment. In turn, this climate of mutual support and understanding provides the student groups with a stronger ability to handle and respond to emerging challenges and risks that were not identified in the original plans, thus avoiding potential conflicts within the group.

Evidence from the student reports suggests that the challenges in the groups were primarily due to a lack of ability to understand each other's viewpoints and not necessarily because of a lack of project structure. Therefore, we suggest that a culture of understanding and respecting each other's viewpoints positively contributes to dealing with emerging challenges or to responding to emerging situations that were not previously identified. The findings also suggest that this culture of understanding and support within the team strengthened the mindset of flexibility and enabled the teams to adapt their plans or objectives when needed. The mutual relationship between these two dimensions is shown in Figure 7.

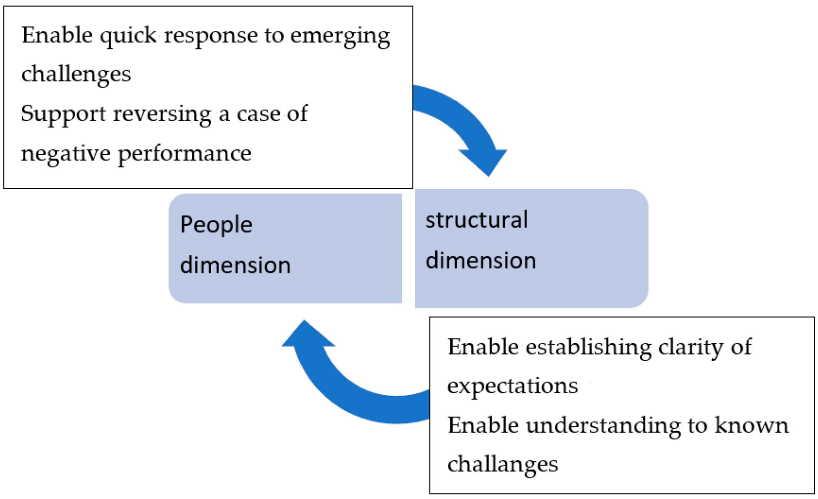


**Figure 7.** The interplay between the two dimensions of enablers of collaboration.

### *Implications for Students*

We suggest that students enrolled in project-based assignments should consider the following lessons learned when they organize their groups:

Communication

- It is critical that all group members are updated at all times regarding project development, challenges, opportunities, and the status of the project. Keeping the group up to date with everything that is happening can potentially save the group time and contribute to the success of the final product. Students should talk directly with one another. In addition, they should ensure that everyone has access to what has been discussed or access to the developed documentation and plans.
- Establish a meeting plan up front and adhere to this meeting plan. These meetings should be used to update each other on progress and discuss new emerging ideas and possible changes. These meetings can be held in person or digitally, if needed.

Collective definition of the project goal, tasks, and expectations

- Initially, ensure that all group members are involved in the definition of the project goal, expectations, and the tasks that should be completed to achieve the goal. This involvement is critical to establish ownership of the goal and of each task in the project.
- Together, develop a time schedule for the tasks and assign roles and responsibilities to each task in the schedule. Ensure that the workload is evenly distributed among the team members.
- Assess the skills needed to complete each task. Evaluate how members can help each other to gain the required skills or knowledge if someone is lacking the required skills or knowledge.
- Continuously revisit the project plan to understand the status and the next step in the project.

Be flexible

- Changes and adaptations in project assignments are inevitable, regardless of the level of detail of the plan. Do not stick to a plan that will lead to a product that does not match the group's ambition.
- Change the plan when needed and always focus on developing the product for the better.

Soft skills

- Seek to create a conducive working environment within the team. Focus on trust-building measures. Be honest and be respectful of each other's viewpoints and support each other when needed.
- Be open about problems and concerns during the execution phase to create and strengthen an honest and supportive atmosphere.

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## References


1. Albanese, M.A.; Mitchell, S. Problem-based Learning: A Review of Literature on Its Outcomes and Implementation Issues. *Acad. Med.* **1993**, *68*, 52. [CrossRef]
2. Lenz, B.; Wells, J.; Kingston, S. *Transforming Schools Using Project-Based Learning, Performance Assessment, and Common Core Standards*; John Wiley & Sons: Hoboken, NJ, USA, 2015.
3. Bransford, J.D. *How People Learn: Brain, Mind, Experience, and School*; National Academies Press: Washington, DC, USA, 1999. [CrossRef]
4. Prince, M.J.; Felder, R.M. Inductive Teaching and Learning Methods: Definitions, Comparisons, and Research Bases. *J. Eng. Educ.* **2006**, *95*, 123–138. [CrossRef]
5. Kokotsaki, D.; Menzies, V.; Wiggins, A. Project-based learning: A review of the literature. *Improv. Sch.* **2016**, *19*, 267–277. [CrossRef]

6. Blumenfeld, P.C.; Soloway, E.; Marx, R.W.; Krajcik, J.S.; Guzdial, M.; Palincsar, A. Motivating Project-Based Learning: Sustaining the Doing, Supporting the Learning. *Educ. Psychol.* **1991**, *26*, 369–398. [CrossRef]
7. Chen, C.-H.; Yang, Y.-C. Revisiting the effects of project-based learning on students' academic achievement: A meta-analysis investigating moderators. *Educ. Res. Rev.* **2019**, *26*, 71–81. [CrossRef]
8. Thomas, J.W. *A Review of Research on Project-Based Learning*; Autodesk Foundation: San Rafael, CA, USA, 2000.
9. English, M.C.; Kitsantas, A. Supporting student self-regulated learning in problem-and project-based learning. *Interdiscip. J. Probl.-Based Learn.* **2013**, *7*, 6. [CrossRef]
10. Markham, T.; Larmer, J.; Ravitz, J. *Project Based Learning Handbook: A Guide to Standards-Focused Project Based Learning for Middle and High School Teachers*; Buck Institute for Education: Novato, CA, USA, 2003.
11. Virtue, E.E.; Hinnant-Crawford, B.N. "We're doing things that are meaningful": Student Perspectives of Project-based Learning Across the Disciplines. *Interdiscip. J. Probl.-Based Learn.* **2019**, *13*, 9. [CrossRef]
12. Jonassen, D.H. Instructional design models for well-structured and III-structured problem-solving learning outcomes. *Educ. Technol. Res. Dev.* **1997**, *45*, 65–94. [CrossRef]
13. Adderley, K. *Project Methods in Higher Education*; Society for Research into Higher Education: London, UK, 1975; Volume 24.
14. Helle, L.; Tynjälä, P.; Olkinuora, E. Project-Based Learning in Post-Secondary Education—Theory, Practice and Rubber Sling Shots. *High. Educ.* **2006**, *51*, 287–314. [CrossRef]
15. Gordon, R. Balancing real-world problems with real-world results. *Phi Delta Kappan* **1998**, *79*, 390.
16. Hussein, B. *Let us Really Learn from Projects: A Study on Learning in Project-Based Organizations—The Ivar Aasen Project*; Fagbokforlaget: Bergen, Norway, 2020; p. 169.
17. Zollo, M.; Winter, S.G. Deliberate learning and the evolution of dynamic capabilities. *Organ. Sci.* **2002**, *13*, 339–351. [CrossRef]
18. Kolb, D.A. *Experiential Learning: Experience as the Source of Learning and Development*, 2nd ed.; Prentice-Hall: Englewood Cliffs, NJ, USA, 1984.
19. Heo, H.; Lim, K.Y.; Kim, Y. Exploratory study on the patterns of online interaction and knowledge co-construction in project-based learning. *Comput. Educ.* **2010**, *55*, 1383–1392. [CrossRef]
20. LaForce, M.; Noble, E.; Blackwell, C. Problem-Based Learning (PBL) and Student Interest in STEM Careers: The Roles of Motivation and Ability Beliefs. *Educ. Sci.* **2017**, *7*, 92. [CrossRef]
21. Turner, J.; Mulholland, G. Enterprise education: Towards a framework for effective engagement with the learners of today. *J. Manag. Dev.* **2017**, *36*, 801–816. [CrossRef]
22. Herber, D.R.; Deshmukh, A.P.; Mitchell, M.E.; Allison, J.T. Project-Based Curriculum for Teaching Analytical Design to Freshman Engineering Students via Reconfigurable Trebuchets. *Educ. Sci.* **2016**, *6*, 7. [CrossRef]
23. Lasserre, P. Adaptation of team-based learning on a first term programming class. In Proceedings of the 14th Annual ACM SIGCSE Conference on Innovation and Technology in Computer Science Education, Paris, France, 3–7 July 2009; pp. 186–190.
24. Mantawy, I.M.; Rusch, C.; Ghimire, S.; Lantz, L.; Dhamala, H.; Shrestha, B.; Lampert, A.; Khadka, M.; Bista, A.; Soni, R.; et al. Bridging the Gap between Academia and Practice: Project-Based Class for Prestressed Concrete Applications. *Educ. Sci.* **2019**, *9*, 176. [CrossRef]
25. Shen, Z.; Jensen, W.; Wentz, T.; Fischer, B. Teaching Sustainable Design Using BIM and Project-Based Energy Simulations. *Educ. Sci.* **2012**, *2*, 136. [CrossRef]
26. Rambocas, M.; Sastry, M.K.S. Teaching business management to engineers: The impact of interactive lectures. *IEEE Trans. Educ.* **2017**, *60*, 212–220. [CrossRef]
27. Boaler, J. Open and closed mathematics: Student experiences and understandings. *J. Res. Math. Educ.* **1998**, *29*, 41–62. [CrossRef]
28. Schneider, R.M.; Krajcik, J.; Marx, R.W.; Soloway, E. Performance of students in project-based science classrooms on a national measure of science achievement. *J. Res. Sci. Teach. Off. J. Natl. Assoc. Res. Sci. Teach.* **2002**, *39*, 410–422. [CrossRef]
29. Ngereja, B.; Hussein, B.; Andersen, B. Does Project-Based Learning (PBL) Promote Student Learning? A Performance Evaluation. *Educ. Sci.* **2020**, *10*, 330. [CrossRef]
30. Hussein, B.; Ngereja, B.; Hafseld, K.H.J.; Mikhridinova, N. Insights on Using Project-Based Learning to Create an Authentic Learning Experience of Digitalization Projects. In Proceedings of the 2020 IEEE European Technology and Engineering Management Summit (E-TEMS), Dortmund, Germany, 5–7 March 2020; pp. 1–6. [CrossRef]
31. Karaçalli, S.; Korur, F. The Effects of Project-Based Learning on Students' Academic Achievement, Attitude, and Retention of Knowledge: The Subject of "Electricity in Our Lives". *Sch. Sci. Math.* **2014**, *114*, 224–235. [CrossRef]
32. Hussein, B.; Wolf, C.; Mikhridinova, N. Evaluating the Impact of Involving Students in Producing Learning Aids in Project Management. The Animation Project. In Proceedings of the 2019 10th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS), Metz, France, 18–21 September 2019; p. 1148.
33. Bovill, C.; Cook-Sather, A.; Felten, P.; Millard, L.; Moore-Cherry, N. Addressing potential challenges in co-creating learning and teaching: Overcoming resistance, navigating institutional norms and ensuring inclusivity in student–staff partnerships. *High. Educ.* **2016**, *71*, 195–208. [CrossRef]
34. Ralph, R.A. Post secondary project-based learning in science, technology, engineering and mathematics. *J. Technol. Sci. Educ.* **2016**, *6*, 26–35. [CrossRef]

35. Guo, P.; Saab, N.; Post, L.S.; Admiraal, W. A review of project-based learning in higher education: Student outcomes and measures. *Int. J. Educ. Res.* **2020**, *102*, 101586. [CrossRef]
36. Powell, L.M.; Wimmer, H. Evaluating students' perception of group work for mobile application development learning, productivity, enjoyment and confidence in quality. *Inf. Syst. Educ. J.* **2016**, *14*, 85.
37. Panasan, M.; Nuangchalerm, P. Learning outcomes of project-based and inquiry-based learning activities. *Online Submiss.* **2010**, *6*, 252–255. [CrossRef]
38. Aldabbus, S. Project Based Learning: Implementation and Challenges. *Int. J. Educ. Learn. Dev.* **2018**, *6*, 71–79.
39. Drain, M. Justification of the Dual-Phase Project-Based Pedagogical Approach in a Primary School Technology Unit. *Des. Technol. Educ. Int. J.* **2010**, *15*, 7–13. Available online: https://ojs.lboro.ac.uk/DATE/article/view/1500 (accessed on 14 June 2021).
40. Krajcik, J.; Blumenfeld, P.C.; Marx, R.W.; Bass, K.M.; Fredricks, J.; Soloway, E. Inquiry in project-based science classrooms: Initial attempts by middle school students. *J. Learn. Sci.* **1998**, *7*, 313–350. [CrossRef]
41. Hallermann, S.; Larmer, J.; Mergendoller, J.R. *PBL in the Elementary Grades: Step-by-Step Guidance, Tools and Tips for Standards-Focused K-5 Projects*; Buck Institute for Education: Novato, CA, USA, 2011.
42. Tseng, K.-H.; Chang, C.-C.; Lou, S.-J.; Chen, W.-P. Attitudes towards science, technology, engineering and mathematics (STEM) in a project-based learning (PjBL) environment. *Int. J. Technol. Des. Educ.* **2013**, *23*, 87–102. [CrossRef]
43. Miller, M.; Hadwin, A. Scripting and awareness tools for regulating collaborative learning: Changing the landscape of support in CSCL. *Comput. Hum. Behav.* **2015**, *52*, 573–588. [CrossRef]
44. Edelson, D.C.; Gordin, D.N.; Pea, R.D. Addressing the Challenges of Inquiry-Based Learning Through Technology and Curriculum Design. *J. Learn. Sci.* **1999**, *8*, 391–450. [CrossRef]
45. Pucher, R.; Lehner, M. Project Based Learning in Computer Science—A Review of More than 500 Projects. *Procedia Soc. Behav. Sci.* **2011**, *29*, 1561–1566. [CrossRef]
46. Mitchell, J.E.; Rogers, L. Staff perceptions of implementing project-based learning in engineering education. *Eur. J. Eng. Educ.* **2020**, *45*, 349–362. [CrossRef]
47. Littleton, K.; Miell, D. (Eds.) 'Learning to collaborate, to learn': Editorial introduction. In *Learning to Collaborate, Collaborating to Learn*; Nova: New York, NY, USA, 2004.
48. Notari, M.; Baumgartner, A.; Herzog, W. Social skills as predictors of communication, performance and quality of collaboration in project-based learning. *J. Comput. Assist. Learn.* **2014**, *30*, 132–147. [CrossRef]
49. Wolff, C.; Olaso, J.R.O.; Bushuyev, S.; Sachenko, A.; Ciutene, R.; Hussein, B.; Torvatn, T.; Arras, P.; Reimann, C.; Dechange, A.; et al. Master level education in project management—The EuroMPM model. In Proceedings of the 2017 9th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS), Bucharest, Romania, 21–23 September 2017; pp. 836–842.
50. Hussein, B. A Blended Learning Approach to Teaching Project Management: A Model for Active Participation and Involvement: Insights from Norway. *Educ. Sci.* **2015**, *5*, 104–125. [CrossRef]
51. Parviainen, P.; Tihinen, M.; Kääriäinen, J.; Teppola, S. Tackling the digitalization challenge: How to benefit from digitalization in practice. *Int. J. Inf. Syst. Proj. Manag.* **2017**, *5*, 63–77.
52. Andriole, S.J. Five Myths About Digital Transformation. *MIT Sloan Manag. Rev.* **2017**, *53*, 20–22.
53. Palmer, S.; Hall, W. An evaluation of a project-based learning initiative in engineering education. *Eur. J. Eng. Educ.* **2011**, *36*, 357–365. [CrossRef]
54. Benbasat, I.; Goldstein, D.K.; Mead, M. The Case Research Strategy in Studies of Information Systems. *MIS Q.* **1987**, *11*, 369–386. [CrossRef]
55. Glaser, B.G.; Strauss, A.L. *Discovery of Grounded Theory: Strategies for Qualitative Research*; Routledge: London, UK; New York, NY, USA, 2017.
56. Ritchie, J.; Lewis, J.; Nicholls, C.M.; Ormston, R. *Qualitative Research Practice: A Guide for Social Science Students and Researchers*; Sage: London, UK, 2014.
57. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]
58. Frith, H.; Gleeson, K. Clothing and embodiment: Men managing body image and appearance. *Psychol. Men Masc.* **2004**, *5*, 40. [CrossRef]
59. Boyatzis, R.E. *Transforming Qualitative Information: Thematic Analysis and Code Development*; Sage: London, UK, 1998.
60. Cicmil, S.; Marshall, D. Insights into collaboration at the project level: Complexity, social interaction and procurement mechanisms. *Build. Res. Inf.* **2005**, *33*, 523–535. [CrossRef]
61. Hussein, B. *The Road to Success: Narratives and Insights from Real-Life Projects*; Fagbokforlaget: Bergen, Norway, 2018.
62. Bond-Barnard, T.; Fletcher, L.; Steyn, H. Linking trust and collaboration in project teams to project management success. *Int. J. Manag. Proj. Bus.* **2018**, *11*, 432–457. [CrossRef]
63. Pinto, J. *Project Management: Achieving Competitive Advantage*, 3rd ed.; Pearson: Harlow, ND, USA, 2013.
64. Kerzner, H. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*; Wiley: Hoboken, NJ, USA, 2013; p. 1264.
65. Chatzoglou, P.D.; Macaulay, L.A. Requirements capture and IS methodologies. *Inf. Syst. J.* **1996**, *6*, 209–225. [CrossRef]

66. Hussein, B.A.; Pigagaite, G.; Silva, P.P. Identifying and dealing with complexties in new product and process development projects. In *Selected Papers from the 27th IPMA, Proceedings of the 2014 International Project Management Association, Dubrovnik, Croatia, 26 June 2016*; Radujkovic, M., Vukomanovic, M., Wagner, R., Eds.; Elsevier Science BV: Amesterdam, The Netherlands, 2016; Volume 119, pp. 702–710.
67. Srinivasan, J.; Lundqvist, K. Using Agile Methods in Software Product Development: A Case Study. In Proceedings of the 2009 Sixth International Conference on Information Technology: New Generations, Las Vegas, NV, USA, 27–29 April 2009; pp. 1415–1420. [CrossRef]
68. Siddique, L.; Hussein, B.A. Grounded theory study of the contracting process in agile projects in Norway's software industry. *J. Mod. Proj. Manag.* **2016**, *4*, 53–62.
69. Siddique, L.; Hussein, B.A. Enablers and barriers to customer involvement in agile software projects in Norwegian software industry: The Supplier' s perspective. *J. Mod. Proj. Manag.* **2019**, *7*, 93.
70. Dvir, D.; Lechler, T. Plans are nothing, changing plans is everything: The impact of changes on project success. *Res. Policy* **2004**, *33*, 1–15. [CrossRef]
71. Bass, B.M.; Riggio, R.E. *Transformational Leadership*, 2nd ed.; L. Erlbaum Associates: Mahwah, NJ, USA, 2006.
72. Azim, S.; Gale, A.; Lawlor-Wright, T.; Kirkham, R.; Khan, A.; Alam, M. The importance of soft skills in complex projects. *Int. J. Manag. Proj. Bus.* **2010**, *3*, 387–401. [CrossRef]
73. APM. *APM Competence Framework*; Association for Project Management: Buckinghamshire, UK, 2008.
74. Ngereja, B.J.; Hussein, B. Critical Soft Factors for Optimum Performance of Maintenance Operations. *J. Eng. Proj. Prod. Manag.* **2019**, *9*, 107–114. [CrossRef]
75. Sudhakar, G.P.; Farooq, A.; Patnaik, S. Soft factors affecting the performance of software development teams. *Team Perform. Manag. Int. J.* **2011**, *17*, 187–205. [CrossRef]
76. Hussein, B.; Hafseld, K. Organisational influences impacting user involvement in a major information system project: A case study in a governmental organisation. *Int. J. Proj. Organ. Manag.* **2016**, *8*, 24–43. [CrossRef]
77. Deep, S.; Gajendran, T.; Jefferies, M. A systematic review of 'enablers of collaboration' among the participants in construction projects. *Int. J. Constr. Manag.* **2019**, 1–13. [CrossRef]
78. Ghazinejad, M.; Hussein, B.A.; Zidane, Y.J.T. Impact of Trust, Commitment, and Openness on Research Project Performance: Case Study in a Research Institute. *Soc. Sci.* **2018**, *7*, 22. [CrossRef]
79. McLeod, L.; MacDonell, S.G. Factors that affect software systems development project outcomes. *ACM Comput. Surv.* **2011**, *43*, 1–56. [CrossRef]