A practical guide to integrating project-based learning into a curriculum to foster a competence-based learning environment

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Abstract

Project-based learning is an effective approach for developing subject-specific, method-specific, social, and personal competencies in university students. Development in higher education calls for integrating such courses into existing curricula. This might be challenging due to the lack of experience as well as time and knowledge constraints of the lecturers to design such courses. Yet, also integrating such courses into existing curricula can be challenging due to resource constraints. Therefore, we report on a practical guide for lecturers on how to design and implement a project-based learning environment that fosters subject-specific, method-specific, social and personal competencies. In the course Agro-Food Projects students of agricultural and food sciences at ETH Zurich work in teams to tackle practice-relevant, authentic, and complex challenges provided by a practice partner from the agri-food sector. The course follows a structured schedule with predefined deliverables and deadlines to promote self- and team-directed learning. Key elements for success include clear responsibilities among teaching staff, a well-organized schedule, and comprehensive support for students. Coaches play a crucial role in guiding the project teams while encouraging autonomy, ensuring that students engage actively with their projects. This course setting provides actionable strategies to encourage educators to implement effective project-based learning which fosters an environment where students take ownership of their learning journey.

Introduction

Practical experience, teamwork abilities, self-reliance, a sense of responsibility, communication skills, and intercultural, interpersonal and transferable competencies are often prioritized in hiring of university graduates, while subject specific knowledge is taken for granted (Heidenreich, 2016; Robertson-von Trotha, 2009). Graduates of ETH Zurich have excellent subject- and method-specific competencies though their transferable skills and practical experience could be strengthened (La Cara et al., 2023). This issue is also relevant for students in agricultural and food sciences (SVIAL, 2013). The importance of developing transferable competencies in graduates is crucial for these future professionals, as they are expected to be able to address complex local and global challenges.

This suggests that students should be trained beyond subject and method specific competencies to ensure their employability. Experience from higher and adult education shows that interpersonal and transferable competencies are often inadequately developed through standalone courses, as they usually lack aspects of direct application (Gotzen et al., 2012; Arbeitsstelle für Hochschuldidaktik, 2008). In contrast, project-based learning through practical and realistic tasks enhances both, the learning experience and the development of transferable competencies (Sá & Serpa, 2018; Nägele & Stalder, 2017). Addressing these gaps and

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improving the learning of transferable competencies has been a major focus of the AGROfutur degree programme initiative (Walter et al., 2015). Within this revision, the master's course Agro-Food Projects (formerly known as Interdisciplinary Project and, even earlier, Interdisziplinäre Arbeitswoche) was constantly adjusted to the needs of the current demand by the study programme. Throughout the lifetime of this course, an ongoing challenge has been the recruiting of a sufficient number of qualified lecturers, who participate as coaches in this course. This text will outline how these challenges have been addressed and mention the strategies that have been implemented to overcome them.

This project-based course has been a compulsory core component of the agricultural sciences curriculum for nearly thirty years. Since 2011, it has also been available as an elective for food science students (Elmiger, 2021). Since then, this hands-on, practice-oriented course has fostered the development and enhancement of both, subject-specific and transferable competencies. However, the teaching methods and learning content have evolved significantly over time, reflecting changes in higher education and changes in the degree programme. The course transitioned from a block week (Interdisziplinäre Arbeitswoche) during a lecture-free period after the end of the spring semester to a weekly class during the semester, supplemented by additional project days during the lecture-free period after spring semester. Most recently, its learning objectives have been aligned with the newly developed ETH Zurich Competence Framework (ETH Zurich, n.d.-a).

Within this context, our approach towards teaching and learning in this master's course is that students already have a set of experiences in transferable competencies from school, earlier semesters at ETH Zurich as well as from extracurricular activities. We can assume that they use these competencies and that they are capable of learning independently. Therefore, we can demand that students take responsibility for their own learning process and success. Thus, the lecturer's role is to provide the necessary framework and guidance for their self-directed learning by creating learning environments, such as project-based settings, in which students can actively develop, improve and test these competencies. To assist this process, lecturers provide learning material, guiding questions, opportunities for self-reflection, and peer interaction.

In the course Agro-Food Projects, students work in teams to tackle practice-relevant, authentic, and complex challenges provided by a practice partner from the agri-food sector. From our perspective, selecting practice partners with care is essential for successfully implementing this approach in any study programme and to ensure a meaningful and impactful learning experience for students. Practice partners are typically small and medium-sized enterprises, farm owners, or employees of agricultural education and advisory centres. The student teams are confronted with developing practical yet scientifically sound solutions that the practice partner can implement. Students learn to structure and manage a project in a self-organized manner, guiding it from the planning stage through to the results in the format of an oral presentation and written documentation that provide recommended actions for the practice partner. The course offers students a high degree of freedom and allows them, in collaboration with the practice partner, to define how they approach and solve the given challenge. Rather than relying solely on their existing knowledge, students need to transfer and adapt what they have previously learned to new situations to develop effective solutions, both individually and as a team. This often pushes students out of their comfort zones, as they encounter new and unfamiliar problems. Therefore, teaching staff of both study programmes is accompanying and guiding the student teams through the whole process.

Project-based courses typically involve substantial organizational effort, along with significant demands for financial resources and physical space. Additionally, they require skilled teaching staff who are properly trained and prepared for their supportive role (Dirsch-Weigand & Hampe, 2018). Looking ahead, we are likely to encounter constraints in terms of funding, available facilities, and personnel while student number increase steadily (ETH Zurich, n.d.-b). Despite these limitations, the need to incorporate active learning formats in higher education remains

pressing and is one of the central principles of teaching at ETH Zurich (ETH Zurich, n.d.-c). Therefore, the challenge for the lecturer(s) in charge is to design interactive courses that promote sustainable learning and encourage students to be independent, self-motivated, and responsible for their own learning. How can such project-based courses be integrated into an existing or newly developed curriculum without placing excessive demands on resources such as personnel, financing and space? Furthermore, how can lecturers effectively implement project-based learning formats without the need to be experts in competence-based education or providing continuous feedback to every student or group of students?

In this report, we demonstrate how to integrate a project-based course into a curriculum even when faced with limited resources. We offer a practical guide for lecturers seeking to incorporate project-based learning into their teaching portfolios or study programmes in a straightforward and manageable way. Hence, we show that learning can occur anywhere, requiring minimal infrastructure, if the learning environment created supports learning.

A brief overview of the course programme

The master's course Agro-Food Projects runs for one semester, featuring weekly four-hour activity slots (either lectures, discussions or time during which students work on their projects). In addition, the course includes four consecutive project days, culminating in a final event held during the lecture-free period in the third week following the spring semester's end. Students are also encouraged to dedicate time outside of class to advance their projects.[2]

The course is designed around three main learning objectives (see https://vorlesungen.ethz.ch, select spring semester and course unit Agro-Food Projects/Praxisprojekte Agro-Food) and follows a structured schedule divided into specific phases with various learning activities, as shown in the advance organizer (Fig. 1). It includes lecture sessions that provide guidance on what to develop, how to approach it, as well as designated time slots for students to work on deliverables (milestones) and assignments that must be submitted on time. This sequential schedule of predefined deliverables and deadlines fosters commitment and ensures that student teams can complete their projects in time (Fig. 1). Such a structured timeline with fixed deadlines is strongly recommended for the development of self-directed learning environments (reviewed in e.g. Zeller Moser & Jenert, 2018).

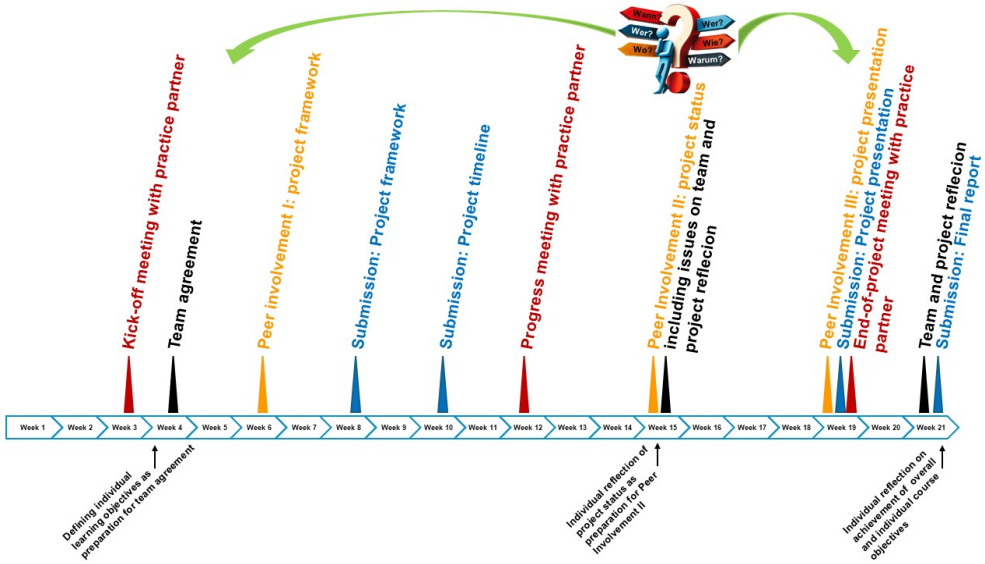

Figure 1: Advance Organizer of the course Agro-Food Project illustrating the course schedule with various tasks and deadlines of deliverables. Blue: deliverables; black: reflection points: orange: peer interaction sequences, red: meeting with practice partner. Additionally, the individual tasks to be submitted are shown on the bottom line, with the arrow indicating when they must be submitted. The figure on the top was prompted with DALL-E.

[2] Readers interested in receiving the detailed course schedule can address the authors of this article.

During the first lecture, students are introduced to the course and its requirements, before the assigned coaches present the available projects and the respective practice partners. Students then use a web application to select and rank their top half of projects by priority. The assignment of the students to one of their selected projects is performed by the core team. It tries to assign the students according to their highest priority, which is not always possible. This method diverges from the recommendation to optimize team diversity by intentionally forming teams with varied, complementary personality types e.g. Belbin[3]. Our approach usually results in project teams in which students work with colleagues they have not collaborated with before. Thus, this simulates a real-world work environment scenario, in which team compositions may not always be ideal. The optimal team size has been found to be four to six students per project. In spring term of 2024, 42 students participated in the course; but in principle the course is designed to scale and accommodate larger student numbers. The teaching staff, so-called coaches, are recruited from professorships teaching at both study programmes (in spring 2024, twenty coaches were involved). The important role of the coaches will be described in detail below.

After the second lecture, the student teams meet with their coaches to introduce each other and prepare for the kick-off project meeting with the practice partner, scheduled for the following week at the partner's location. After visiting the practice partner, students start working on their project by independently determining their approach according to the project questions or problems illustrated by the practice partner with guidance from their coaches.

At this point a challenge might be that students are not familiar with a project-based, active learning environment, because they typically experienced traditional lecture-based teaching and passive learning (reviewed in e.g. Zeller Moser & Jenert, 2018). Thus, students must shift from being passive recipients to active participants (Morrison, 2014), taking ownership of their learning rather than merely absorbing what the study programme provides. To address this important feature, we require students to set their own learning objectives for the course, thereby fostering their sense of responsibility and engagement for their educational journey.
Although the course encompasses elements of project management, teamwork, and transdisciplinary collaboration, these aspects have not been covered by theoretical lectures embedded in the course schedule for the past two years. This change was prompted by student feedback and significant resistance indicating that students did not find these instructions valuable at all to complete their project. Instead, we integrated questions related to these topics into the deliverables, requiring students to engage with and experience these elements implicitly through their work, since we consider them important. This approach has proven effective in prompting students to regularly reflect on these concepts through practical application.

Structured forms and guiding questions support the students to works on tasks and deliverables. In more detail, the following tasks and deliverables[4] are demanded from the students:

Four deliverables: These are required to be submitted at designated times, structuring the project process and guiding students through each step of the course. They are shown in blue in Figure 1.

1. *Project framework*: It ensures that the project work aligns with the assignment from the practice partner, creating a binding agreement for both the student project team and the practice partner.
2. *Project timeline:* It divides the entire project into smaller, manageable segments, allowing for effective planning and execution along the timeline.

[3] See here for more information: https://www.belbin.com
[4] Readers interested in receiving the guiding questions and forms can address the authors of this article.

3. *Project presentation:* It provides an opportunity to showcase their project work, by presenting the developed solutions, and delivering recommendations to the practice partner.
4. *Final report:* It provides an overview of the project's accomplishments and offers the practice partner a comprehensive foundation for implementing the insights and solutions developed by the students' project team.

Three peer-feedback sequences: The course emphasizes peer learning and feedback among groups. The arrangements for these sequences are indicated in orange in Figure 1. Two student teams support each other throughout the project, offering mutual feedback on each other's progress and results. This peer feedback process together with the input from the practice partner and the coaches enhances both the learning experience and the overall project outcome. It also helps students to improve their communication competencies and their ability to handle feedback, while promoting reflection on the project's progress within the teams.

- *Peer Involvement I*: Partner teams collaboratively review and discuss each other's project framework.
- *Peer Involvement II*: Each project team evaluates their current project status, analysing challenges in three key areas: team collaboration, team communication, and work organization. The team engages with the peer team to explore these issues and develop an action plan to ensure successful project completion. This sequence includes issues of team- and project reflection.
- *Peer Involvement III*: Practice and refine the project presentation in collaboration with the peer team and coaches, incorporating their feedback to improve the final delivery.

Three reflection points: The schedule and submission deadlines for the reflection points are indicated in black in Figure 1.

- *Defining individual learning objectives*: Students outline their individual subject-specific, method-specific, social, and personal learning objectives which they wish to achieve during the course. These objectives are regularly reviewed, assessed, and reflected throughout the course. They also serve as a foundation for the team agreement and the project reflection.
- *Team agreement*: In the team agreement, students of each team formalize a shared understanding on how they will collaborate with one another, the coaches, and the practice partner of the team. They establish agreed-upon guidelines for structuring their teamwork to achieve their subject-specific, method-specific, and social objectives.
- *Project reflection*: The project reflection serves as a retrospective for the student teams to review the entire project and to draw key lessons for future projects or their upcoming master's thesis. This reflection process includes evaluating their learning journey, project outcomes, team collaboration, interactions with coaches, and the transdisciplinary experience of working with a practice partner.

Key aspects for course success

For effective learning in project-based courses, clear and binding rules for students should be established (reviewed in e.g. Zeller et al., 2018). Within this framework, student teams are given the autonomy to self-organize. Three key elements have been identified which are crucial for the success of the course.

A. Clear responsibilities for the course: Core team and coaches

The teaching staff consists of the core team and the project assigned coaches, with core team members also partly serving as coaches. The core team holds overall responsibility for the course, which includes managing deliverables, ensuring their quality, and resolving any issues or conflicts within student teams, between students and coaches, or with practice partners. It may intervene in an advisory, mediating, or decisive action when necessary.

In the preparatory phase, the core team, in collaboration with coaches, selects appropriate practice partners and project ideas. Projects that offer students hands-on experience and opportunities to develop creative solutions are especially motivating.

Throughout the course, the core team provides lecture content. It organizes and moderates the starting and closing event. The core team also conducts a learning goal-oriented evaluation of the course. Additionally, the core team is responsible to check for the timely submission of student assignments, the final assessment of all student deliverables and assignments, as well as for performance assessments.

B. Well-organized course structure and clearly defined schedule

The course framework and performance assessment criteria are outlined in the course catalogue (see https://vorlesungen.ethz.ch, select spring semester and course unit Agro-Food Projects/Praxisprojekte Agro-Food). Moreover, the course schedule is explained in detail in the first lecture. Additionally, the binding submission deadlines as well as what is expected from the students, who participate in this course, is explained in detail at the beginning of the course. At the start of each input class, the advanced organizer (Fig. 1) is referenced to show students their current progress and what they are expected to do or elaborate during the upcoming weeks. Strict adherence to the schedule and deadlines is emphasized, ensuring that project teams remain on track (reviewed in Sukackė et al., 2022). All learning materials as well as the templates for deliverables and tasks are available in the corresponding Moodle course.

C. Well-defined framework and comprehensive student support

Given the wide variation in project topics, approaches, practice partners, and team constellations, three main learning objectives serve for the common understanding of the expected outcome of the course. Students are encouraged to actively contribute their knowledge and creativity to their projects, thereby taking ownership of their learning journey. They are responsible for driving their own learning success, managing the project work, as well as fostering the development of their peer team. Intrinsic motivation to participate in this project-based course is generally high, as students appreciate the opportunity for this unique hands-on learning experience.

Student teams are expected to proactively consult and coordinate with their coaches on plans and upcoming steps and are required to regularly update them on project progress and deliverable status. Feedback from coaches, and when necessary, the core team, must be discussed within the team and integrated into the project development.

To mitigate the risk of students disengaging in project-based learning, participation rules are clearly communicated and enforced. Additionally, challenges within the team, with practice partners, or with coaches, can negatively impact the learning experience. This risk is addressed by establishing a team agreement at the start of the course, providing team members a reference point for collaboration. Furthermore, the core team serves as mediator when conflicts arise.

Who are the coaches and what is their role?

Coaches are experienced teachers or doctoral students who already possess a high level of teaching skills. They are recruited across professorships of both degree programmes. As a result, minimal time, e.g. a two-hour workshop, is required to prepare them for their role in the course. The core team and coaches meet twice during the course to exchange insights into student teams and practice partners to mitigate any issues that could arise.

Each student team is assigned two coaches, ensuring continuity and coverage in case of scheduling conflicts. Many coaches commit to this role for several years. New coaches are preferably paired with experienced ones, who support them to learn their role. However, a

potential challenge is the lack of suitable coaches to support the project-based course, particularly when no appropriate personnel are available within the professorships.

The major role of the coaches is to guide and support the student teams as a 'guide on the side' (King, 1993) throughout the learning process. Their role is to support, and, when necessary, steer the work and learning process of the student teams in the right direction. This is achieved through feedback and by initiating the student's reflection processes, as suggested for example by Bachmann (2018) when creating learner-centred courses. Their supervision follows the principle of minimal assistance: 'As little help as possible, as much help as necessary' (Aebli, 2011). Furthermore, coaches monitor the quality of deliverables and provide suggestions for improvement (feedforward) on the final presentation, project work, teamwork, and final report. They can also intervene to mediate conflicts or involve the core team if needed.

How to find rooms and learning space

A single large plenary room is available that accommodates all students. However, it is not designed for team-based work. Unfortunately, there are no rooms nearby available where teams can collaborate, interact, and exchange ideas. To facilitate these productive interactions, we make use of the courtyard in the lecture building as a workspace (Fig. 2). Each team is provided with a bench set, presentation material, and a poster board. Coffee and cookies are offered. This setup has proven to be highly effective, creating a familiar and productive working environment that encourages collaboration within teams, across teams, and between teams and coaches. Thus, even without fully equipped rooms for project-based learning, other locations can be easily transformed to serve as an interactive working and learning space.

Figure 2: Student teams working in the courtyard of the LFW-building, a familiar and productive working atmosphere which facilitates intense collaboration and exchange within teams, among teams, and among the coaches of different teams. Photos by Brigitte Dorn, D-USYS.

How to create the 'performance assessment'

Various forms of competence-oriented performance assessments are discussed, and rubrics have been proposed as a tool to help students prepare for these assessments (e.g. Zimmermann, 2018). However, the acquisition of transferable competencies is not 'testable' factual knowledge; it can only be assessed, if at all, in action-oriented situations or through a

developmental process in which students repeatedly engage with their competence acquisition (Arbeitsstelle für Hochschuldidaktik, 2008).
In group work, a key challenge is distinguishing individual contributions from the collective output of the team. Under these circumstances, an objective, precise, and reliably differentiating grading of the performance of individual team members is only possible with significant effort (Glathe & Schabel, 2014).

Due to the diversity of project topics, the individual and team performances are not comparable among the different project teams. Performance assessment is structured around a series of deliverables and tasks that require continuous engagement from students, both individually and as a team. It follows a 'pass' or 'fail' model. To pass, students must complete all tasks and deliverables and demonstrate active participation in the project work. Failure to do so, either through insufficient engagement or incomplete submission of required materials, may result in a failing grade. A good project result can only be achieved if students of a team cooperate. Students are required to work on the deliverables and tasks in a qualitatively appropriate manner. As stated in the course catalogue, attendance and active participation in the course are mandatory, and these requirements are enforced and checked by both the coaches and the core team.

Students in agricultural and food sciences have already acquired subject-specific and method-specific competencies during their bachelor's studies, such as scientific writing, presentation skills, and laboratory work. In the master's course Agro-Food Projects students must be able to adapt these competencies to the specific requirements of the project they are working on and the overarching learning objectives, following the instructions given during the course.

How can we identify whether the students have met the main learning objectives and reached their self-set learning objectives?

A. Main learning objectives

To assess whether students met both the course's main learning objectives of the course as well as their self-set learning objectives, a modified version of the learning goal-oriented evaluation (Frank et al., 2019) was conducted with participants from the spring semester of 2024. This method combines the results of quantitative and qualitative answers and prompts students to reflect on their learning, thereby identifying areas that were supportive for learning and areas where they faced challenges. Additionally, tailored evaluations, designed to suit the specific type and structure of a course, provide feedback by uncovering course weaknesses. This approach not only highlights areas for improvement but also serves as a form of feedforward, helping to enhance individual course quality, more effectively than the standardized course evaluations commonly used (Beywl et al., 2011; Frank et al., 2019).

Students rated their achievement of the three main learning objectives as well as their self-set subject-specific, method-based, social, and personal learning objectives by using a four-point Likert scale: a) fully achieved, b) partially achieved, c) rather not achieved, and d) not achieved. This four-point scale was intentionally chosen to avoid neutral responses to encourage a more decisive evaluation. To provide insights to the evaluation, students were also asked to explain their ratings.

Since completing the evaluation was compulsory for the performance assessment, forty out of 42 students participated (two students still needed to complete the evaluation). The results indicate that students generally met the main learning objectives of the course (Fig. 3), suggesting a good alignment between the course content, structure, and objectives. 72.5% of the students reported that they fully achieved the first learning objective of '*working in a team and developing scientifically sound, practical solutions to the questions posed by the practice partner*', while 27.5% reported at least partial achievement. For the second learning objective of '*preseningt the developed solutions in oral and written form in a comprehensible, convincing*

and appropriate manner', 92.5% of students felt they had fully achieved this objective, while 7.5% reported partial success. Notably, for the third learning objective of '*reflecting on the work process and the project result individually, in the team, with the coaches and the practice partner and drawing conclusions for their actions in the current project and for future team and project work*', 87.5% of students felt they had fully achieved this goal, while only 12.5% indicated partial achievement. None of the students reported failing to achieve any of the three main learning objectives.

After the final project presentation, the student team, the coaches and the practice partner meet for mutual exchange and structured feedback on their project. This session is an essential element of the final event. Here, coaches and practice partners meet with the student team and comment on their performance. This feedback is highly appreciated by students, offering a far deeper appreciation than a numeric grade ever could. It is often during this session that students fully realize the impact of their work and its significance for everyone involved, in particular for the practice partner.

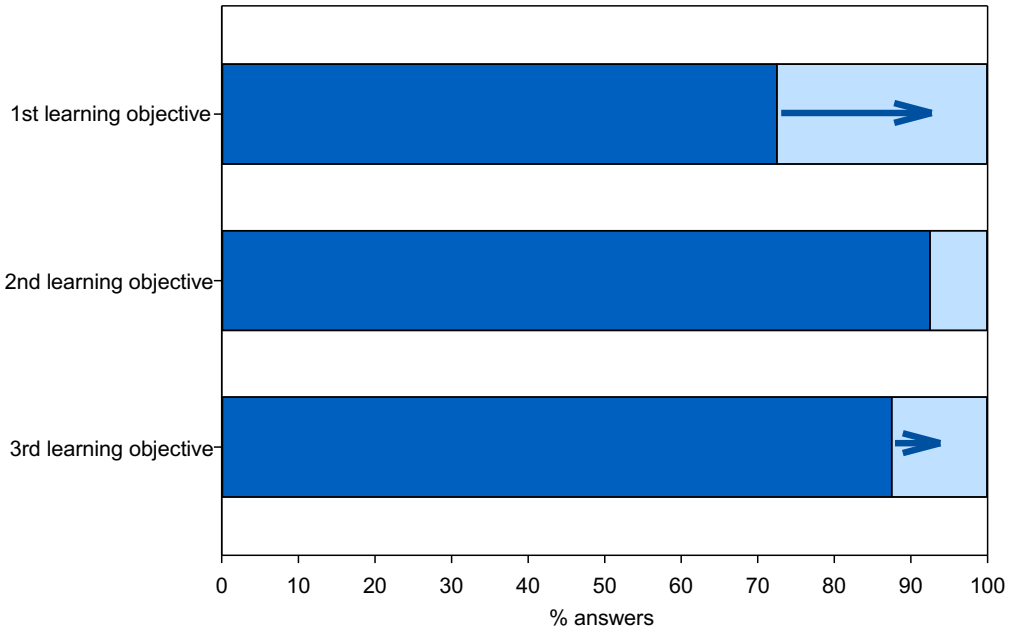

Figure 3: Achievement of the three main learning objectives in % of the answers. Arrow in the bar of the 1st learning objective indicates the eleven answers that could be moved towards 'fully achieved' indicating that all students achieved the first learning objective when analysing the text answers. Arrow in the bar with the 3rd learning objective indicates the four answers that could be moved towards 'fully achieved'. 4-point Likert scale (fully achieved, partially achieved, rather not achieved, not at all achieved), n = 40. Dark blue: fully achieved; light blue; partially achieved. None of the students answered with 'rather not achieved' or 'not at all achieved'.

However, what do these estimates really mean? To offer an insight into the student's perception of learning, we present three representative explanations from students who selected 'fully achieved'.:

- *Our question was completely different from what we learned at ETH, but we managed to find the solution as best we could through good research. But what was almost more important in our project was to apply the knowledge from our studies.*[5]
- *We were looking for solutions to a real problem. Several ideas were considered until we finally decided on the parameters we investigated. Although we were not able to definitely solve the problem, we were able to make a good suggestion.*[7]
- *I fully achieved this learning objective, as we developed and implemented the variety garden as a team, which can be used in teaching. It is therefore suitable for practical use and the fact sheets are scientifically sound.*[7,6]

[5] The original text was translated from German to English.
[6] For visual insights into one of the projects see (both last retrieved September 27, 2024):
1. https://usys.ethz.ch/news-veranstaltungen/news/archiv/2024/07/getreidesorten-neu-entdeckt.html
2. https://www.tiktok.com/@eth_dusys/video/7407334674030185761?lang=de-DE

An analysis of the students' written responses revealed that the few students who selected ‘partially achieved’ equally engaged in thorough and scientific work (see statements below). However, they evaluated their engagement more critically than their colleagues who chose ‘fully achieved’. They were notably critical of the reliability of their solutions by citing insufficient data collection or insufficient literature or experimental data found to support firm conclusions for the practice partner. These eleven responses could be, in connection with the text analysis, classified as 'fully achieved’, indicating that all students successfully met the first learning objective (blue arrow in Fig. 3).

- *We made a strong effort to develop a scientifically sound approach, but there were many limitations and compromises had to be made. Nevertheless, the results were presented in the right context and offer interesting insights despite the limitations.*[7]
- *We worked on a scientific question as a team and also successfully conducted an experiment, but the result has not yet generated a practical output.*[7]

Similarly, when analysing the text responses by ‘partially achieved’ of the third main learning objective, one student had completed the wrong answer, and the response was corrected to ‘fully achieved’. The four remaining responses highlighted the value given of the peer feedback and reflection process, suggesting these students aligned more closely with 'fully achieved' rather than 'partially achieved' for the third learning objective (blue arrow in Fig. 3). The insight into their perspectives could be summarized as follows:

- *The back-and-forth exchange of ideas among all project participants was a very valuable method for receiving feedback and generating new ideas. This was especially important because our prior work on the different products often prevented us from taking on a fresh perspective – something that was sometimes necessary to fix even obvious mistakes.*[7]
- *I found the final discussion together with practice partners and coaches very useful to reflect on the project work again. However, I'm not sure how much I personally gained from all the assignments. I found it more draining than useful. I also found the first two peer involvements only moderately helpful. However, the third one, where we practiced the presentation together, was much more beneficial.*[7]

B. Self-set subject-specific, method-specific, social, and personal learning objectives

Students reported unanimously that they achieved their self-set subject-specific, method-specific, social, and personal learning objectives, indicating that the course fosters the learning of these important transferable competencies. 65.0% of the students claimed to have fully achieved the self-set subject-specific, 72.5% the method-specific, 75.0% the social, and 72.5% the personal learning objectives (Fig. 4). At first glance, these evaluations of the achievement of self-set learning objectives seems low. However, a deeper analysis of the text responses revealed that students again were highly self-critical in their evaluations of their achievements. Interestingly, 5% (2 out of 40) of the students indicated that they did not achieve their social learning objectives. One student mentioned ongoing difficulties with understanding and communicating in German, while the other expressed disappointment over not being able to engage as deeply with stakeholders as desired.

Therefore, it can be argued that students did, in fact, learn what the course aimed to promote: the improvement of important transferable competences such as teamwork, communication skills, critical thinking, problem solving and interpersonal skills by interacting with team members and practice partners. However, many were highly critical when evaluating their self-set learning objectives. This could suggest that students may not yet be familiar with defining their own learning objectives as well as to learn in competence-based and project-based courses.

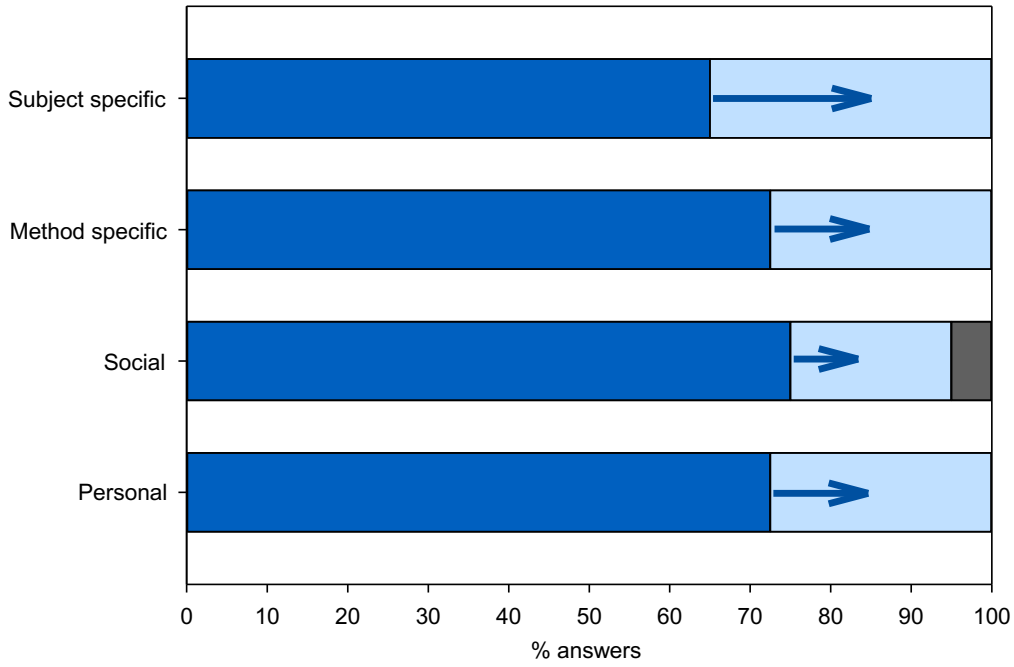

Figure 4: Achievement of the self-set subject-specific, method-specific, social and personal learning objectives in % of the answers. Arrow in each bar indicates that, including the text responses to the evaluation, would move the achievement rate towards higher answers for 'fully achieved'. 4-point Likert scale (fully achieved, partially achieved, rather not achieved, not at all achieved), n = 40. Dark blue: fully achieved; light blue; partially achieved; grey: 'rather not achieved'. None of the students answered with 'not at all achieved'.

Conclusion

This practical guide demonstrates how a project-based course can be effectively integrated into a curriculum, even with limited personnel, financial, and spatial resources. We also emphasize that these learning environments can remain simple, as effective learning in a project-based setting does not require complex infrastructure or an elaborate methodological framework. Furthermore, incorporating peer feedback, peer collaboration, and guided self and team reflection enhances critical thinking and fosters deeper learning. We suggest that a similar course outline could be easily adapted to other project-based learning environments in other study programmes wishing to incorporate project-based learning into their teaching portfolio or their study programmes in a straightforward and manageable manner. Nevertheless, guidance from experienced teaching staff is essential for success of project-based learning ultimately resulting in students taking ownership of their individual and team learning journeys. A potential challenge could be determining where to place a project-based course within the structure of a study programme. We recommend allocating at least one full afternoon for such a course. This would give student teams the flexibility to work on their projects, conduct experiments, travel to meet practice partners, or visit experts without time constraints. Our core insight over the years being responsible for this course is that a successful project-based learning environment relies on three key resources: engaged practice partners, a sufficient number of motivated coaches and a core team leading the course. Practice partners must be committed to collaborating with both coaches and students and offering a meaningful challenge for students to work on.

Or as students put it:

- *The course is very well organized and offers an incredibly great opportunity to work with a client in a very practical way. I was able to benefit from this course on various levels (professionally, methodologically, socially) and it also contributed a lot to my personal development.*[7]
- *Have faith in the process. In the beginning, it may seem like you will never reach a usable end product with your project work. But it can be compared to a small trickle of water that slowly makes its way and eventually develops into a river.*[7]

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Declaration of generative AI and AI-assisted technologies: The authors used DeepL Write and ChatGPT (Version 3.5) to prompt English translation and elaborated a combined version of the two texts. Perplexity AI was used to co-create the abstract. The authors take full responsibility for the content of the publication.

Acknowledgments

We express our special thanks to all the coaches and students who participated in this course over the past years. Their valuable feedback has been continuously incorporated to improve the course. A special thanks to all the practice partners who shared their challenges with the students. Leo Meile, Emmanuel Frossard, Urs Brändle, Gabriel Kaufmann and in particular Eva Buff Keller all contributed to a major extent over the past decade to slowly transform the formerly Interdisziplinäre Arbeitswoche to the Agro-Food Project. Manuel Sudau, Educational Developer at D-USYS, prompted the figure with six sign shapes in Fig. 1.

We thank the ETH Zurich Ethics Commission for guidance on retrospectively handling student's course evaluation data, as it was not initially intended for publication. Students were retrospectively informed by email about our publishing plans and given 10 days to deny participation of their answer in the data analysis. When the e-mail was sent, credits had already been decreed. None of the students denied from publishing their evaluation data for this article.

Lastly, we thank the two anonymous reviewers and the journal's editors who kindly provided constructive feedback for improving our manuscript.