



# Collaborative problem solving: A pedagogy for workplace relevance

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## Abstract

Collaborative problem solving (CPS) is a widely used pedagogical approach in work-based learning. To facilitate the complex process of situated learning, researchers have emphasized the need for scaffolding to enable learning of skills while engaged in problem-solving. While CPS as a pedagogical practice has mainly been examined in classroom situations, a research gap exists in studies of CPS in real-world contexts. In this study, we contribute to the understanding of CPS by examining the contextual characteristics that shape students' and teachers' experiences in situated learning. Consequently, we present a multi-case study to investigate involvement of a business professional as a source for scaffolding on site, in a hotel business environment. We employed a qualitative, multi-case methodology in the study. An ill-structured, real-world problem of food waste in the hotel service sector was presented to students (N = 72) and their accompanying teachers (N = 9) from second and tertiary education. They were provided with access to expert knowledge and opinion by industry professionals (N=5) on site. We collected data via observations, interviews, and questions from the involved stakeholders in three physical locations in Denmark and in Finland. Additionally, we documented their experiences using an online collaboration tool in each case. Despite the scaffolding provided by the business professionals, students underused the resources available for their learning in the extended learning environment. Students benefited from guided exploration of the problem space, structured feedback, and teacher interventions, resulting in improved perspective taking, participation, social regulation, task regulation and knowledge building.

**Keywords:** collaborative problem solving, situated learning, instruction, case studies



## Introduction

Collaborative problem solving (CPS) is a widely used pedagogical approach in work-based learning and work-integrated learning. Defined as a performance activity that requires a group of learners to work together to solve problems, CPS is essentially a social form of learning (Harold et al., 2003). In CPS learners interact purposefully to transform a current state into a desired goal state (Hesse et al., 2015, p. 39; O'Neill et al., 2004), while using their teamwork, communication, leadership and problem solving skills (Oliveri et al., 2017.)

To facilitate this complex process, researchers have emphasized the need for scaffolding to enable learning of skills while engaged in problem-solving (Loes & Pascarella, 2017). Despite of this concern for preparing students with the right skills set for the world of work, research in CPS has been completed mainly in classroom situations (see e.g., Carnevale et al., 1990; Ruder et al., 2018), where a group of students are engaged in a simulation with the purpose of solving a clearly defined problem statement under supervision of a teacher. A research gap exists in studies of CPS in real-world contexts, where students receive support for their collaborative inquiry from an experienced practitioner, a business professional.

In this study, we aim to contribute to the understanding of CPS by examining the contextual characteristics, e.g., situational clues, form of feedback and scaffolding available, that shape students and teachers experiences in situated learning. Consequently, we present a multi-case study to investigate involvement of a business professional as a source for scaffolding on site, in a hotel business environment. In the cases, an ill-structured real-world problem of food waste in the hotel service sector was presented by a business professional. Defined as unconsumed food at all stages – from food production to consumption (Juvan et al., 2018), *food waste* is a significant issue for the hotels, as for the whole food service sector.

The qualitative data in the form of interviews, observations and anonymous answers to question prompts on the online collaborative tool were collected in Denmark and Finland, over the course of a 12-month period from September 2019 to September 2020, by carrying out four experiments, each involving different groups of students, teachers, and business representatives. Two of the groups studied culinary studies in Vocational Education and Training (VET) and two service, tourism and hospitality management in Higher Education (HE). Three physical locations were used with varying contextual characteristics to investigate the enablers and restrictors for CPS with similar and varying prompts for the assignment. The online collaboration tool Mentimeter was used to voice out students and teachers experiences from these interactions during and after the experiments.

## Theoretical framework

Research has pointed out that workplace learning is characterized as experiential, social, situated and practice bound (Tynjälä, 2014). When students embark in the world of work, they encounter real-world problems that are often messy, ill-defined, and ill-structured (Xun et al., 2016). In education, pedagogical approaches such as collaborative problem solving (CPS) are used to advance students' preparation to professional practice. Whereas in the classroom situations, CPS follows a structure of well-defined initial state, and a known goal state, learners in professional contexts face objectives that are vaguely defined or unclear.

In the practice-based theorising of knowing and learning in organizations, attention is directed to situated learning and learners' capacity to think and act collectively and cooperatively *in situ* (Gherardi, 2000). Furthermore, learners need scaffolding for their learning (Zheng et al., 2019), especially in development of purposeful collaboration patterns (Chang et al., 2017). In this paper, we take CPS to the workplaces, and investigate students' and teachers' interaction in their attempts to occupy a problem space and to solve a real-world problem. The metaphor of scaffolding is used here in the sense of cognitive support given from more experienced others to allow students to solve tasks that they would not be able to solve working on their own. In classroom situations, teacher scaffolding is temporary support such as questions, feedback, and explanations, enabling students to initiate and carry out their CPS activities (Haataja et al., 2019; Fernández, 2015). In our study, we examine scaffolding as support for student collaborative inquiry from an experienced practitioner, who interprets students' need for support, intervenes when necessary and fades out when students' actions and competence allow it. In accordance with Wood's et al. (1976) introduction to the concept, scaffolding has become a widely used concept in CPS, offering a metaphor for the process where a more knowledgeable other guides students' emerging understanding and allows them to engage with the learning affordances at hand (Raes et al., 2012; Rojas-Drummond et al., 2020; Wu, 2020).

In retrospective, pedagogical approaches such as CPS are motivated not only by scholarly contributions. Graduates' employability continues to be a concern for policy makers and educational institutions alike (Powell & Walsh, 2018). The OECD and European Union have addressed the need to advance working life orientation in education. In Europe and North America, this discourse has been recognised as work-based learning (WBL), whereas in Australia and New Zealand the same approaches have become familiar as work-integrated learning (WIL). Within both discourses, CPS has been examined as a pedagogical approach to combine learning in educational institutions and student exposure to the world of work (Jackson, 2018), and to advance the knowledge of individuals and organisations through interactions with peers (Scardamalia &

Bereiter, 2014). However, purposeful social actions, such as learning, are seldom accomplished simply by placing students in workplace situations.

Pedagogy for workspace relevance relies on industry, and as aptly stated by Jackson (2019, p. 220), ‘networking opportunities and insight into professional practice, aiding both career development learning and professional identity formation’. Furthermore, research has also explored student metacognition during collaborative learning (Biasutti & Frate, 2018) and student learning style, satisfaction, and sense of community in hybrid environments (Chen & Chiou, 2014). Hence, research should critically examine what factors enable or restrict students’ situational learning.

CPS of ill-structured problems involves multiple problem spaces and representations. Ill-structured problems are typically situated and emerging from a specific context. Moreover, they are not constrained by the content domains being studied at the classroom (Jonassen, 1997, p. 68). The process of CPS requires active manipulation of the problem space (Esereyel et al., 2013, p. 445). In this attempt, several cognitive and metacognitive processes take place. Xun and Land (2004) have proposed a framework, where CPS of highly contextualised problems are seen as two self-regulatory cycles, namely those of problem representation and solution generation. In each of these cycles, the learner is engaged in phases of planning, execution, and reflection, while encountering the different situational clues in the problem domain and context. To facilitate this complex process, researchers have emphasized the need for scaffolding to enable learning of skills while engaged in problem-solving (Loes & Pascarella, 2017). In the following, we take a step towards the world of work, and explore the context of hotel business environment. We elaborate the ill-defined problem students, teachers, and industry professionals encountered as socially constructed realities (Guba & Lincoln, 2005). Hence, we employ an epistemological stance of interpretivism, with the aim to understand the subjective meanings constructed by the participants as part of the CPS processes (Kaplan & Maxwell, 1994; Orlikowski & Baroudi, 1991).

### **Food waste in the food service sector**

Defined as unconsumed food at all stages – from food production to consumption (Juvan et al., 2018), food waste is a significant issue for the food service sector. The food service sector in the European Union alone produces 21 kilos of food waste per person annually (Stenmarck et al., 2016). This not only has a detrimental impact on the environment, but on social and economic drivers as well (Gustavsson et al., 2011). Research has revealed that food waste can be reduced by creating cooperative strategies for staff (Oliveira et al., 2016; Pirani & Arafat, 2016), educating customers (Sakaguchi et al., 2018), and selecting managerial decisions regarding food planning operations, such as actively

measuring food waste (Sakaguchi et al., 2018), selecting serving styles which are better for reducing food waste – e.g., avoiding buffets and opting for *à la carte* services (Papargyropoulou et al., 2019) or providing ‘nudging’ strategies for customers (Kallbekken & Sælen, 2013).

Such strategies can reduce food waste generation in the industry, yet a fundamental change in mind-set on how to approach food waste is sorely needed, particularly with developed countries’ issue of surplus food. As Garrone et al. (2014, p. 129) stressed, a ‘bottom-up approach is needed to understand and model surplus food generation and management throughout the supply chain’. To understand and address this gap, it is critical to take into account social aspects of management and professional skills, as when ignored, the programmes are prone to failure (Heikkilä et al., 2016). Culinary schools and other hospitality management educational institutions are therefore an integral part in educating current and future employees in having the necessary professional skills regarding food waste.

Based on this, we seek answers to the following research questions:

*RQ1: How do contextual characteristics in workplace situations affect problem representation and solution generation in CPS?*

*RQ2: What meanings do students and teachers attach to learning affordances in CPS when given access to expert knowledge and opinion?*

With this article, we contribute to the field by providing an innovative and collaborative learning method involving educators, learners, and practitioners.

## Methods and materials

A multi-case study approach was used, with two cases taking place in Denmark and two in Finland over a course of one year, from September 2019 to September 2020. Case-studies have long been heralded as a powerful teaching tool, as they are ‘stories that represent real, complex and contextualised situations, which often involve dilemmas, conflicts or problems with no obvious solution’ (Davis, 1993, cited in Escartín et al., 2015, p. 47). While case-studies were originally designed for the classroom, our case-studies were conducted on-site (at the case study company’s location), an expansion of the learning environment which is often dismissed (Sommarström et al., 2017).

Due to the nature and goals of this study, the approach could from a preliminary glance be defined as either a set of case studies (multi-case study) or action research – a distinction educational researchers are still working on (see Sáez Bondía & Cortés Gracia, 2022), since case studies have often been used as an umbrella term, and numerous classifications and methodological considerations tend to overlap and have complementary goals and functions. We define this

study as a multi-case study approach based on two rationales, namely that (1) the nature of action research’s reflective cycles is not present in our study, and (2) the phases of research in a case study are more appropriate in how this study was conducted. This is explained in greater detail below:

1. Action research aims to improve educational practices by means of reflective cycles (Bergmark, 2022), where particularly teachers aim to solve a particular issue (often immediately). Case studies, oppositely, focuses on understanding (classroom) situations in real contexts, and are conducted over a longer period of time and focus more on observing and analysing a particular phenomenon. Our approach did not call for teachers to reflect, and thereby (re)implement their reflections for improved educational practices. Rather, our study focused on observing and analysing a phenomenon through multiple cases, and we (as researchers) functioned as external agents ‘facilitating the collection and processing of the data’ (Sáez & Carretero, 1996, p. 42). Moreover, we did not intervene during the case to alter the outcome of the students’ learning affordances. Our only intervention was to ensure a smooth process of the framework, not to assess different potential issues or outcomes immediately.
2. When comparing the features in the phases of research between action research and case studies presented by Sáez Bondía and Cortés Gracia (2022), this study aptly fits the case study approach (see table 1).

*Table 1. Summary features between AR and CS approaches: Phases of research.*

<b>Action Research</b>	<b>Case Study</b>
1. Identifying and clarifying the change 2. Recognising and reviewing of the problem 3. Structuring the plan to change 4. Implementing action research 5. Evaluating the action trough reflection and starting a new action-reflection cycle	A. Preliminary planning: literature review and research B. Choicing and establishing of boundaries between the case and the context C. Designing the case D. Preparing the data and collation and collating data E. Data analysis, interpretation and report writing

Source: Sáez Bondía and Cortés Gracia (2022, p. 860).

Students (N = 72) from second and tertiary education (Vocational Education and Training, VET, and Higher Education, HE) participated across the four case studies, as well as their accompanying teachers (N = 9), and the relevant on-site industry professionals (N = 5). The line of education was identical between the two VET and the two HE student groups. The case studies in Denmark took place

at two stand-alone upscale hotels in Sønderborg, a town of 28,000 inhabitants. The case studies in Finland took place at a franchise hotel in Pori, a town of 85,000 inhabitants. Although all case studies followed the same structure and collected similar kind of data, each case study contained minor variations within the framework. This variation of the contextual characteristics is illustrated in table 2.

Table 2. Case-specific context for CPS, 2019–2020.

Case study	Contextual characteristics examined	Participants	Education
DK1 27 September 2019 09:00-14:00	Access to how an expert thinks Setting where skills can be accumulated	1 teacher 5 students 1 executive chef 2 facilitators	VET - Culinary Studies
FI1 22 November 2019 9:00-13:00	Access to how an expert thinks Setting where skills can be accumulated Structured feedback	3 teachers 16 students 1 hotel manager 2 facilitators	VET - Culinary Studies
DK2 23 September 2020 09:00-14:00	Access to expert skill and opinion from a variety of sources Setting where skills can be accumulated Students able to move at will	1 teacher 12 students 1 executive chef 1 marketing coordinator 1 hotel manager 2 facilitators	University of Applied Sciences - Service, tourism and hospitality management
FI2 23 September 2020 12:00-16:00	Access to expert skill and opinion from a single source Setting where skills can be applied Students able to move at will Unstructured feedback	4 teachers 39 students 1 hotel manager 2 facilitators	University of Applied Sciences - Service, tourism and hospitality management

To ensure that the hotels would be capable host sites for our multi-case studies, the hotels were selected based on several criteria, namely (i) food waste (and its subsequent reduction), in particular the morning buffet, has been on the strategic agenda for the hotels, (ii) the hotels had made previous attempts to reduce food waste, but with limited success, and (iii) had previous collaborations with VET and HE schools.

All student groups consisted of both men and women, young students in their initial vocational training and adult learners who were upskilling to new occupational positions. The student groups in total presented an age range of 16 to 54 years. In this study, we adopted the Framework of Teachable Collaborative Problem Solving Skills by Hesse et al. (2015, p. 43–48), so that the case-study programmes were arranged in five phases, each phase containing specific tasks and questions to the students, teachers, and industry professionals (experts). Hence, the CPS followed the stages of 1) Perspective taking, 2) Participation, 3) Social regulation, 4) Task regulation, and 5) Knowledge building.

### **Scaffolding for examining the problem space**

In each case, the simulation started with the working life representative contextualising the problem-solving situation with implications to the organisational strategies, policies and practices on site. This included e.g. a Green Key certificate for sustainable development in a hotel environment, a description of sustainability actions in use within services offered to the customers and the way it affects the work of different staff members in the company.

The researchers instructed students and teachers to document and present the different stages of the CPS process using Post It-notes and posters. The restaurateur or hotel manager (the expert) presented the problem to the students on a deliberately general level, in order to allow student creativity to step in and formulate their understanding of the problem in question. Students were advised to ask further clarification from the expert, in order to make full use of the learning affordances available on site. Teachers were asked to observe the learning curve and collect the students' social and cognitive skills during the CPS process using the elements, indicators and levels of performance (low–middle–high) presented in the Framework of Teachable Collaborative Problem Solving Skills (Hesse et al., 2015, pp. 43–48). Together with the framework completed by the teachers, researchers were able to study the students' learning process and the importance of case-specific context for their CPS, by means of an online collaboration tool, Mentimeter.

The Mentimeter tool was used to make visible the students' strategies of interaction in the problem space – defining the problem to be solved and attempting to solve it. The students were presented with questions to help monitor and reflect on their learning process. By using mobile devices, students logged into an online presentation where they answered questions and respectively, saw each other's answers in real time, yet anonymously presented by the software (see tables 3–7). After the CPS process had concluded, teachers were invited to reflect on the case with questions of their own presented with the Mentimeter tool.



Two researchers were engaged with the scaffolding of each case study, taking pictures, and making notes on their observations, and comparing them later in the research team in order to compose a thick description of the contextual characteristics and the social meanings presented by the participating stakeholders in the cases. We documented and stored answers to the online collaboration tool questionnaire as part of the qualitative data. Furthermore, researchers collected the teachers' observations through short interviews after each case in order to collect direct feedback from the teachers about their experience and the students' learning process for which they had a rather passive role, compared to a normal teaching setting in the classroom.

In the first (DK1) and third cases (DK2), the students had tours of the hotel prior to being introduced to CPS of the ill-structured problem. Each study also had a different setup with regards to which industry professionals were present to offer scaffolding (see table 1), not only for presenting the ill-structured problem, but also for clarifying questions and giving feedback when the students were pitching their solution(s). The DK1 case gave access to the way an expert would think with a single industry professional, whereas the DK2 case setting enabled students with access to expert skill and opinion from a variety of sources. In both cases, the students were given freedom with as far as how to tackle the ill-defined problem (i.e., using mind-mapping tools for brainstorming, physically investigating the areas where food waste is an issue, etc.), as well as how their teachers wished to interact with them.

In the second case (FI1), the venue for collaborative problem solving took place in a multipurpose room adjacent to the hotel pub, situated across the street of the main hotel building. Contextual clues were presented only through presentation and dialogue with the hotel manager. These included statistics of food waste produced by guests at the breakfast buffet, measured by the hotel staff over a period of 10 days. Further prompts included classification of hotel guests (e.g., ratio of business travellers or families with children) each day and amount of waste generated by calendar day (with significant variation between week and weekend days) and staff job categories involved in the breakfast buffet planning, preparation, and delivery. In this case, the dialogue with the hotel manager gave access to the way an expert's opinion and perspective, giving prompts on how to address the customers with information on food waste. The venue provided the learners with a semi-authentic setting where skills can be accumulated but did not give access to direct application.

In the fourth case (FI2), the venue for CPS was the authentic restaurant for breakfast located in the main hotel building. Along with the prompts mentioned earlier, students could move freely in the space and observe the actual display of the buffet offerings such as equipment and accessories, along with the hotel campaign to reduce food waste placed on boards on the walls and brochure

holders on the tables. In both FI1 and FI2, the hotel manager provided the scaffolding to the students. However, the cases differed on how feedback was given. In FI1, access was given access to experts' opinion and perspectives, followed with structured feedback between the student groups. In FI2, access was given to expert skill and opinion, but facilitators left the feedback between students unstructured. In conclusion, we examined in regards of the first research question how situational clues, form of feedback and scaffolding available affect problem representation and solution generation in CPS.

In the following, we shortly clarify the Collaborative problem solving protocol applied in our case studies. We use table analysis to give voice to students, teachers and business professionals, and their direct experiences, as they occupy a highly contextual and ill-structured problem space (Baxter & Jack, 2008). We investigate similarities and differences between and across the cases, with the attempt to contribute to the research gap mentioned and to identify protocols for future case studies (Yazan, 2015).

#### *Phase 1: Perspective taking*

In Perspective taking, the key learning activity examined was student ability to consider others' perspectives, taking the contributions of others into consideration and adapting behaviours to those of others to enable mutual modelling. Prior to each case study, the experts and the teachers involved were briefed on the nature and purpose of the case study by the facilitators. In this phase we investigated how broadly or accurately a problem should be presented to enable students to work collaboratively to define (and redefine) the problem statement.

#### *Phase 2: Participation*

In the second phase, the key learning activity was readiness to share information and externalise thoughts, and to participate in collaborative ideation. Student interactions were observed to examine activity in the environment. Teachers also assessed individual student perseverance in completing the task. In examining the contextual characteristics in this phase, we experimented with situational clues related to students either roaming freely in the space or attending a guided walk in the venue. Furthermore, contextual characteristics involved in the experiments varied between teacher high- and low-level participation in accommodating learning.

#### *Phase 3: Social regulation*

In the third phase, the key learning activity was awareness of strengths and weaknesses – those of oneself and of other group members – and the group social skills in collaborative problem solving. In this phase, we experimented with

pedagogical design to accommodate feedback between students and between students and experts.

*Phase 4: Task regulation*

In the fourth phase, the key learning activity was planning and monitoring skills for developing strategies towards problem solving and shared problem representation. In this phase, we experimented with pedagogical design on how to facilitate the role of business professional(s) as a source for scaffolding.

*Phase 5: Knowledge building*

In the fifth and last phase, the key learning activity was ability to learn and build knowledge through group interaction, and self-reflection over own actions and ability to solve a work-based problem. In this last phase, we investigated the meanings students and teachers attached to getting access to expert opinion and perspective during the collaborative problem solving, and what benefits it heralded to their situational learning.

## Results

In the following, we investigate the impact of contextual characteristics to students' and teachers' interaction across and between the case studies, and study how they experienced the use of industry professionals as a source for scaffolding. The case studies yielded several novel insights and recommendations, as well as suggestions for future studies. We compile the students' views presented via the Mentimeter tool, and teachers' views presented both with Mentimeter and with interviews to tables, to accompany our analysis on each phase of the CPS.

### **Perspective taking: Engaging with the problem statement**

In the Perspective taking phase, students were invited to answer the following questions to study the individual and collaborative problem identification and representation:

- Was the problem too defined or opened to pursue?
- How did you help others to understand the problem?

As a result, across all the cases, we found that it was imperative to discuss between experts and teachers prior to CPS on how to formulate the problem statement, considering the baseline understanding of the specific student group. This was particularly made apparent in the two Danish case studies, where the executive chef in the case DK2 presented the problem in a far too general manner

(and hastily), thus resulting in a third of the class stating that the problem was defined as too open to pursue (see table 3).

Table 3. Contextual characteristics in Perspective taking – quotations.

	Students	Teachers
Access to a way an expert would think	‘It wasn’t too clear but it gave room for our own thinking’ ‘We started by discussing why customers take too much food in the first place’	‘It was OK how he presented, but it went a bit too fast for the students. He threw around several terminologies that students wouldn’t know yet’ ‘To some extent, maybe too good tips were given’
Structured feedback	‘It progressed our own ideas’ ‘We developed new ideas based on their feedback’	‘I interrupted them a little bit, for example to make them think from a larger perspective’
Unstructured feedback	‘There was not much feedback’ ‘She was an observer and help us to stay on the right track’	‘The executive chef needs to explain a bit more from what he wanted but (researchers) helped to ask follow-up questions to explain the problem in a bit more detail’
Setting where skills can be accumulated	‘You will never get answers if you don’t ask, and you can only get wiser’	‘Being outside the classroom really adds a new dimension – the students take it more seriously’ ‘I got to see my students operate in another environment that they are not used to’

Regarding the initiation of CPS process in the Perspective taking, challenges were found when allowing the expert to present their perspectives on the food waste case study. This was reflected in the subsequent interviews with the teachers when prompted whether the problem was explained in too much detail. In the case of DK2, teachers saw that researchers’ additional scaffolding was the needed enabler for student reflection and inquiry in the problem space.

However, the need for limited, adjusted, and temporary support in perspective taking remained negotiable. As perceived oppositely in the case FI2, the teachers claimed a too much detailed description of the problem as an unnecessary restrictor for CPS. Hence, our findings relate to other studies, which have marked the value of preparing the ill-structured problem ‘precisely enough’, in order to create conditions for collaborative problem solving in a level just beyond the existing abilities, hence providing scaffolding for learning (Margolis, 2020, p. 23; Verenikina, 2012; Vygotsky, 1979). Consequently, describing the problem at

an optimal level enabled co-construction of knowledge between students and their teachers. In addition, experimenting with a style of feedback as a contextual characteristic proved to be paramount for student learning: structured feedback acted as an enabler and unstructured feedback as a restrictor for the Perspective taking.

**Participation: Teacher offering temporary support with learning affordances**

In the participation phase, students were invited to answer the following questions to investigate their interaction within the group and with the teacher:

- How did you as a group support each other's opinions/ideas?
- How do you see the role of the teacher in the group work?

In this study, the venues themselves differed as between a venue where skills can be accumulated to a venue where skills can also be applied. We observed that students were able to engage proactively with the available learning affordances due to being able to walk around in a real-life setting and gather personal experiences. By having the industry professionals conduct a tour of the hotel, this further allowed the students to understand the framework which they were working with. These findings are in line with Wells (1999) who argues that scaffolding should scrutinise the kind of activity in which knowing is embedded and consider the role of artefacts that mediate knowing, to allow learning at the zone of proximal development (Wells, 1999, p. 12). In our study, the possibility to move at free will in the problem space with the professionals, allowed perspective taking and participation beyond the scope of a normal classroom.

In one case (DK2), a teacher also emphasized the importance of receiving feedback from industry professionals on their developed ideas on-site. Scholars have argued that students (particularly in business studies) are struggling with critical reflection – both of their own and others' work (Tomkins & Ulus, 2015). Receiving constructive criticism from a professional was, according to their teacher, 'a reality check. The executive chef wasn't impressed with all the solutions, but this also gives them a reality check with how to deal with people in the field, and the level with which they are expected to perform'.

While this could be worrying that negative feedback could be detrimental for the students, it is important to remember that studies have revealed negative feedback has no effect on intrinsic motivation when compared to neutral or no feedback, and was also less demotivating when paired with instructions on how to improve, as well as using criterion-based standards and being delivered in person (see Fong et al., 2019). This was also echoed in the DK1 case, where the teacher stated that coming from an industry professional, feedback was 'more credible'. Furthermore, by commenting that student ideas may have a 'direct

impact on his business', the teacher further emphasized the significance of the now established connection between education and the world of work.

Table 4. Contextual characteristics in Participation – quotations.

	Students	Teachers
Access to expert skill and opinion	<p>'Gave us facts that we need to use for our idea'</p> <p>'Used it to formulate new ideas'</p> <p>'Gave me much better idea on what was possible/realistic to do as a solution'</p> <p>'To help us develop our idea'</p>	<p>'It was very important – I might be able to say that their idea is very good, but there is a certain level of expertise that coming from the sous-chef that makes it more credible. He will also be more critical of their ideas, because it is something that would have a direct impact on his business'</p>
Structured feedback – teacher high level of participation	<p>'She asked good questions to the expert that we hadn't thought of'</p> <p>'She came with great input and was very good at explaining matters if we did not understand the task at hand'</p> <p>'We took all feedback and reflected to take a new approach to the problem'</p> <p>'She helps us when we got stuck with what to do'</p>	<p>'I also intervened once more when I could see they were getting a bit stuck in a discussion and not making any new ground. But the difference maker was that I knew these students, I couldn't do this if I didn't know them this well'</p> <p>'Yes – because I know my students and they are a bit sluggish to get going. So I knew if I gave them a bit of a kickstart at the beginning, then they would be able to roll the ball themselves, work independently from me'</p>
Unstructured feedback – teacher low level of participation	<p>'Teachers', other students' and hotelier feedback were important'</p> <p>'Contributions of others are used to suggest possible paths'</p> <p>'She is a spy'</p> <p>'I listened all the feedback but I don't feel that based on them, I would change my own behaviour'</p>	<p>'I have really learnt how my new class cooperates in groups – this method is really good at seeing how students interact with one another, for better or worse!'</p> <p>'...Finally, I enjoyed that as a teacher, you also take a more passive approach, in that the students take much more control of their learning, and it's not me whipping them around – it was wonderful to see that so much of their learning was at an arms-length from me'</p>

In our study, scaffolding from professionals enabled students to align their understanding of the problem statement and the solutions generated to the industry needs, specifically with domain specific observations on customer behaviours in tourism and hospitality. In practice, this yielded a deeper understanding on how educational programs should prepare future graduates to address the problem of food waste in hotels. Furthermore, teachers were able to distinguish behavioural patterns between business and leisure time customers in producing food waste in a hotel breakfast buffet. These findings are in line on what is reported on using technology-enhanced scaffolds in classroom problem-solving, e.g., by Kim and Hannafin (2011) who argue that learners may simply comply with directions rather than internalise guidance. On a similar note, McLoughlin (2002, p. 155) suggests that effective scaffolding can reduce the scope for failure and bring learners closer to a state of independent competence. By using technology-enhanced scaffolds, like the Mentimeter used here in this study, we observed that teachers can monitor students' progress in CPS and provide feedback while supporting learner autonomy.

#### **Social regulation: Evaluating the skills of oneself and of the others**

In the social regulation phase, students were asked to reflect the negotiation behaviour in their group:

- Were there conflicts within the group?
- If so, how did you solve them?

Teachers accommodated student learning using prior knowledge of their personality traits. However, experiences of learning were more positive when feedback was structured compared to the case with unstructured feedback. Similar to Lave and Wenger (1991), students' and teachers' meaning making on participation speak for CPS as a negotiated, interactional and bilateral process.

By having facilitators present to steer the students through the various stages of the case studies, the teacher was more readily available to observe the students, as well as provide guidance when needed. The role of researchers as facilitators was to introduce the upcoming phases and make sure the students followed the process of the case. Having the teacher detached from the content of the case allowed the research team to identify that there were several instances of student groups being suspicious of the teacher's role, by e.g., labelling the teacher as a 'spy' (FI2). This is fascinating, as it indicates a sense of ownership of their ideas, solutions and self-agency, important components in settings where an achievement gap exists (Conley & French, 2013).

Table 5. Contextual Characteristics in Social regulation – quotations.

	<b>Students</b>	<b>Teachers</b>
Flexibility and ambiguity – setting goals and collecting elements of information	<p>‘Listening to others’</p> <p>‘Cooperation and creative thinking’</p> <p>‘To help my group to cooperate better in solving the problem’</p>	<p>‘Yes, with the exception of the one group who could not decide on which action to take...’</p>
Resource management – industry professional providing students with instructional scaffolding	<p>‘help us to find answers on the tasks we were trying to solve’</p> <p>‘helped us to further build on our idea on a practical solution’</p> <p>‘We got positive feedback, which spurred us to further work on our ideas’</p>	<p>‘It was super important because it also gave them a reality check. The executive chef wasn’t impressed with all the solutions, but this also gives them a reality check with how to deal with people in the field, and the level with which they are expected to perform.’</p> <p>‘...But all worked together actively – I really enjoyed hearing that from the get-go, everyone used the word we – these are also students who did not know each other a few weeks past, so it was really nice to see that a common task could get them together so rapidly.’</p>

Due to the action-based research approach taken in this paper, it was deemed necessary to have the authors operating as facilitators of the case-studies, while the students’ teachers were given the tasks of evaluating the students’ collaborative problem-solving skills and assisting any of the student groups when necessary. This format proved beneficial to enable students’ self-regulation of learning, which was voiced by a teacher: ‘...You also take a more passive approach, in that the students take much more control of their learning’. Additionally, having industry professionals to provide scaffolding for students’ learning process gave students an understanding of how to engage and behave outside the classroom as a teacher stated: ‘...it gives him/her a reality check with how to deal with people in the field, and the level with they are expected to perform’. Thus, a purposeful pedagogic design combining scaffolding from teachers and experienced practitioners enabled development of students’ agency and industry knowledge in CPS.



### Task regulation: Students rushing into solutions

In this phase, students were asked to reflect on how they utilised the skills and opinions of the business professionals:

- How did you use the feedback given from the expert (e.g., the sous-chef) and the other groups?

Students underused the resources at hand in the business context by not actively collecting elements of information from the industry professional(s) present in the situation. Here our findings contrast to what research states (e.g., Hesse et al., 2015) that the more similar the representations of a problem are in the group, the better the quality of the collaborative problem solving is. We observed that quality of the problem solving may vary also because of how students engage in the learning affordances at hand, and how actively they explore the problem space.

Even though students were given access to expert knowledge in the Task regulation phase it was more used to rubber stamp their own ideas, as seen by the comments from Mentimeter in table 6.

Table 6. Contextual characteristics in Task Regulation – quotations.

	Students	Teachers
Flexibility and ambiguity – setting goals and collecting elements of information	‘Listening to others’ ‘Cooperation and creative thinking’ ‘To help my group to cooperate better in solving the problem’	“Yes, with the exception of the one group who could not decide on which action to take...”
Resource management – industry professional providing students with instructional scaffolding	‘We got positive feedback, which spurred us to further work on our ideas’	‘It was super important because it also gave them a reality check. The executive chef wasn’t impressed with all the solutions, but this also gives them a reality check with how to deal with people in the field, and the level with which they are expected to perform.’ ‘...But all worked together actively – I really enjoyed hearing that from the get-go, everyone used the word we – these are also students who did not know each other a few weeks past, so it was really nice to see that a common task could get them together so rapidly.’

However, based on analysis on the students' answers to the question prompts presented, we can argue that the online collaboration tool enabled students' shared reflection during the CPS while encountering the different situational clues in the problem domain and context.

The experiences voiced out by students are very much in line with previous research on collaborative problem solving where students prefer problem analysis, solution finding and solution implementation, as opposed to problem finding (e.g., Titus & Koppitsch, 2018). Titus and Koppitsch's research further reinforces the dilemma of the ill-structured problem, as they revealed that 'students reported a strong dislike for problems that have no definitive or singularly correct answer' (2018, p. 249).

### **Knowledge building: Differences between classroom and the real world**

In the last phase, students were invited to reflect on their knowledge building:

- In your opinion, what is the most important skill to succeed in the workshop?

In this phase, our analysis of situational learning focused on giving access to expert skills and opinion. Students, particularly in business studies, are frequently given cases where most of the focus and work needed is to provide solutions, and as such, merit is often based on the solution. Yet, according to Basadur et al. (2014), it is adaptability which guarantees companies (and its employees) to thrive. Knowing that adaptability can be explained as a four-stage process of collaborative problem solving, namely generation, conceptualisation, optimisation, and implementation (Basadur & Gelade, 2006), it is vital that students learn to not only focus on developing solutions (optimisation and implementation), but also to proactively acquiesce and generate new information to identify problems (generation), to then analyse the identified problems (conceptualisation) conceptually.

In this study, we found out that teachers were highly satisfied with conducting the case studies on-site in a business environment. In the case DK1, the teacher stated that 'being outside the classroom really adds a new dimension - the students take it more seriously'. The teacher also added an unanticipated benefit, stating that by taking the students on-site, this could 'help the students in the future to secure internships - a good way for them to get noticed and be aware of the options out there'. Compared to a location, where skills can be accumulated, location where skills can be applied yielded a broader scope of perspective taking and participation, thus allowing development of learner agency and self-regulation.

Table 7. Contextual characteristics in Knowledge building – quotations.

	Students	Teachers
Representing and formulating relationships in a situated learning context	'Problems like these cannot be fixed here and now - need long-term solutions' 'There are no easy solutions to complicated problems' 'A good group dynamic is critical for success! Our product/solution was not delivered as wished'	'Being outside the classroom really adds a new dimension - the students take it more seriously' 'I got to see my students in an environment that they are not used to do'
Understanding cause and effect to develop a plan, constructing hypothesis	'A how-to approach to solving things' 'How to develop ideas, and doing so ethically'	I was able to see a 'modern' hotel operate - so I can bring back new ideas for teaching''
Assessing one's and group learning when access to expert skill and opinion	'Guests are not always easy to deal with' 'Other peoples' insight and understanding of an industry'	'This can also help the students to secure internships - good way for them to get noticed/be aware of the options out there'

In this study, students received support for their collaborative inquiry within a real-world context from an experienced practitioner, a business professional. When facing an ill-defined problem and the diverse situational clues present, teacher temporary support was needed to assist students' adaptability in CPS. Hence, we observed that when extending the learning environment from classroom to the workplace, educators need to consider pedagogical design for supporting group interaction and students' self-reflection in addition to the scaffolding provided by an experienced practitioner.

As reflection plays a critical role in work-based learning (e.g., Helyer, 2015), as well as a part of self-regulation in ill-structured problem solving (e.g, Xun et al., 2016), the case studies used three mechanisms to ensure continuous and critical reflection from the students: (i) the Mentimeter online collaboration tool, (ii) feedback from industry professionals, and (iii) feedback from other student groups. The desire to create continuous reflection (as opposed to the standard operating procedure at the end of a case-study) was to not only collect responses from the students' experiences and thoughts on the case-study, but to instigate an interactive reflection process for the students. This allowed the students to not only reflect on their own learning, but also on the feedback received on their case-study work.

The authors observed that by interjecting questions by means of the Mentimeter tool during each collaborative problem-solving phase, the students were made aware of their own learning, having to self-assess their own learning and thus providing learner agency. In addition, by using the Mentimeter tool at intermittent periods (between phases), this made the process more manageable for teacher and students. This was corroborated by a teacher (in case DK2):

I really enjoyed this in terms of how it was structured into different phases, or checkpoints. I liked that it was broken down into phases, which make it more manageable, both for teacher and classroom. I can't bring them out to a case company every time, but I can definitely use this structure to make casework in the classroom more manageable.

Peer-to-peer feedback between students was framed differently across the case studies (see table 1), resulting in varying outcomes. Two types of feedback sessions were seen as the most beneficial for critical reflection and learner agency. In FI1 and DK1, student groups would only present to one other student group and exchange feedback with the same group. The added value was that the feedback was more constructive, and all students in the groups were attentive. Oppositely, in the case FI2, one group would present to all the other student groups and then receive feedback from the entire class of students. Students not presenting were less attentive, and as one student responded about how they worked with the feedback given from their peers: 'we didn't get any feedback'.

The feedback sessions in DK2 functioned as an 'island' concept, where student groups would appoint one student to present their idea to visiting student groups, and the remaining students in the group would visit the other 'islands' to hear about the other groups' ideas. This proved beneficial, as this resulted in (i) constructive feedback from multiple perspectives of different student groups, (ii) students bringing back new and/or revised ideas to implement to their own solutions, and (iii) a rehearsal before presenting their final solution to the industry professionals.

## Discussion

The aim of this paper was to contribute to the understanding of Collaborative Problem Solving (CPS) as a pedagogical approach, with the intention of advancing working life relevance of education. In this paper, we extended the learning environment from the classroom to the workplace and sought to answer how contextual characteristics such as situational clues, form of feedback and scaffolding available affect problem representation and solution generation in CPS (RQ1). With this approach, we intended to provide insights to how these mentioned contextual characteristics either enable or restrict student collaborative inquiry in CPS and, in particular, how workplace situations affect problem

representation and solution generation. We followed the five phases presented in the Framework of Teachable Collaborative Problem Solving Skills by Hesse et al. (2015) to structure our study process and the respective data collection to investigate these research questions.

In our analysis, this approach yielded many novel findings on enablers and restrictors for CPS, when students and teachers are faced with an ill-defined problem in real-world contexts. In the perspective taking phase, scaffolding from a number of business professionals present may enable students to generate multiple views to the problem, in contrast to a scaffolding from one experienced other. In this study, we noted that lack of student prior experience of the workplace context restricted understanding of the ill-structured problem, and the customer social behaviours resulting in food waste at the breakfast buffet. Hence, guided exploration of an authentic context accommodated a better connectivity with the problem statement in contrast to student free roaming in the space. Here we were able to align our observations with findings by Jackson (2019) on the pedagogy of workspace relevance relying on industry support. However, results from our study suggest that intervention may be needed from teachers to direct student attention to defining and re-defining the highly contextualised problem statement, avoiding the rush to generate solutions. Hence, our study relates to the balance between problem representation and solution generation as proposed in the framework by Xun and Land (2004). Consequently, we found a too clear or loose problem statement to be a restrictor to initiate the CPS, causing conflict or distraction in the group collaboration.

Furthermore, we attempted to answer what meanings students and teachers attach to learning affordances in CPS when given access to expert knowledge and opinion (RQ2). In the participation phase, further scaffolding, and structure to CPS from teachers and researchers as facilitators enabled broader perspective taking and participation beyond the scope of a normal classroom. Furthermore, the participation phase provided an opportunity for reflection and enquiry between the students, teachers, and business professionals. This was in line with CPS strategies identified by the research, e.g., Oliveira et al. (2016), Sakaguchi et al. (2018), Papargyropoulou et al. (2019), and Kallbekken and Sælen (2013). In our study, we noted the importance of structured feedback and teacher additional scaffolding in facilitating purposeful collaboration patterns between students. This was evident for collaboration problem solving in highly contextual and ill-structured problem spaces, as described in our multi-case study protocol.

The diverse effects of structured and unstructured feedback were further clarified in the Social regulation and Task regulation phases. Unstructured feedback restricted mutual modelling and lack of teacher scaffolding led students to comply with directions rather than internalise guidance, as suggested by Kim and Hannafin (2011). Furthermore, students underused the opportunity to

engage with the business professionals. As noted by Titus and Koppitsch (2018), students in our cases also preferred problem solution and application in contrast to exploiting the resources at hand to further elaborate and comprehend the ill-defined problem. When extending the learning space from classroom to workplace, teachers and experts on site need to facilitate students' emerging understanding by encouraging them to explore the problem space and engage with the learning affordances at hand. Furthermore, more knowledgeable others may need to direct newcomers' focus by pointing out the situational clues available. Purposeful interactions using questions, feedback, and explanations facilitated learning the most of those students who had no previous experience in operating in the context – whether in the role of a customer or a worker.

In the knowledge building phase, purposeful pedagogical design enabled peer-to-peer feedback and mutual modelling, which further enhanced students' self-regulation and adaptability to address the professionals at the workplace with their solutions, as suggested by Xun et al. (2016) and Helyer (2015). Interventions to reflect the individual and group processes using the online voting tool contributed to student understanding of their own learning and collaboration.

Regarding the ill-structured problem in our study, food waste in the food service sector continues to be a significant global problem, and while our article contributes mainly to further the field's understanding of CPS as a pedagogical approach, the study also contributes to Garrone et al.'s (2014) call for a bottom-up approach of tackling food waste in the supply chain, as well as Oliveira et al.'s (2016) cooperative strategies for staff to reduce food waste. Specifically, our study provided a platform for CPS to be used in a real-life context for both future and current professionals in the food service sector to tackle food waste, where student, teacher, and practitioner could contribute to the self-regulatory cycles of problem representation and solution generation. Our approach helped to break down barriers between the classroom and the 'real world', which should help strengthen similar programmes, and not ensure their failure as Heikkilä et al. (2016) noted.

### **Limitations and future research**

In this research, the authors shed light on collaborative problem solving and ill-defined problems in the setting of the hospitality management industry. Despite the multi-case approach employed in this qualitative study, the sample sizes do not allow us to make generalisations of our findings within education across other disciplines. We collected data via observations, interviews, and answers to question prompts via an online collaboration tool from different stakeholders involved in CPS. However, we acknowledge that data collected using the mentioned methods is self-reported and hence cannot be independently verified.

The social interactions analysed in the study may contain bias due to e.g., students attributing positive events and outcomes to one's own agency but attributing negative events and outcomes to external forces (other students, teachers). Furthermore, bias may be generated by teachers and researchers possibly exaggerating the significance of some events (group conflict), due to the situational and highly contextual nature of this experimental study.

We identified a number of future study protocols for interpretative multi-case studies. Research should investigate what personal factors hinder students from using the resources made readily available to them in an authentic, real-world context. More detailed study is also needed to evaluate whether more structured peer-to-peer feedback at multiple stages of CPS would yield to improved agency and self-regulation in students.

Despite the limited time for student and teacher exploration in the problem space, the findings in this study implies that a shared understanding of ill-defined problems in the group can be facilitated through purposeful design of scaffolding. Further study is needed to explore pedagogical design for combining scaffolding from teachers and experienced professionals in CPS, in particular among students with low self-regulation skills and agency.

## Conclusions

Due to the mentioned limitations of this qualitative multi-case study, we cannot make any generalisations of our data. However, the findings of this study add knowledge about use of CPS as a pedagogical approach in education. We sought to answer how contextual characteristics such as situational clues, form of feedback, and scaffolding available affect problem representation and solution generation in CPS. In addition to scaffolding provided by the business professionals, students benefited from structured feedback and teacher interventions, resulting in improved perspective taking, participation, social regulation, task regulation, and knowledge building as presented in the Framework of Teachable Collaborative Problem Solving Skills by Hesse et al. (2015). We also wanted to know what meanings students and teachers attach to learning affordances in CPS when given access to expert knowledge and opinion. Teachers appreciated the opportunity to get access to expert skill and opinion, allowing updates of their own professional skills and competences. Teachers also acknowledged the value of the mentioned framework in constructing sequencing to learning in CPS at the classroom. The learning affordances for student and teacher exploration in the study, namely the authentic business context with access to expert skill and opinion, resulted in adapting and incorporating contributions and prompts from others. Use of multiple business professionals as experts lead to increased audience awareness in students, and the use of an

online inquiry tool allowed to evaluate the strengths and weaknesses in individual and group levels. Both students and teachers favoured the use of the Mentimeter online collaboration tool to assist reflection and inquiry during the CPS process.

The specific contextual characteristics of each case study were authentic business contexts with access to expert skill and opinion, thus served as learning affordances for student and teacher exploration in the study. Learning affordances from contextual characteristics resulted in adapting and incorporating contributions and prompts from professionals, teachers, and students. Use of multiple business professionals as experts and interactions between students, teachers, and business professionals lead to increased audience awareness in students. Furthermore, contextual characteristics increased problem awareness and complexity in each case setting thus students and teachers realised food waste as a multi faced solution. From generic understand of a problem to a concrete problem. From generic solution to specific context dependent solution.

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