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RESEARCH

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Creating better internships by understanding mentor challenges: findings from a series of focus groups

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Abstract

Background Despite demands to make higher education more relevant beyond academia, and a growing body of work testifying to the benefits of work-relevance programs (e.g., work-placements, or internships) for both students and the companies that host them, there is limited information available for those aiming to optimize these programs. For example, few have explored the challenges and needs of internship supervisors. Here, we focus on the experiences of supervisors in biology and geology programs across three Norwegian institutions. Specifically, through a series of focus groups, we asked internship supervisors about their motivations for serving as student mentors, any challenges they had faced, and what higher-education institutions could do to better prepare them for hosting students at their workplaces.

Results Key challenges faced by supervisors include the need to tailor placements to individual student needs and capabilities, navigating the constraints imposed by academic structures, and addressing communication gaps between students, institutions, and workplace supervisors. Internship supervisors suggest enhancing communication strategies to better define roles and expectations, increasing support and training for supervisors, and establishing clearer, more collaborative frameworks for setting learning objectives with students.

Conclusions The supervisors' suggestions aim to ensure that internships are mutually beneficial, supporting both students' educational outcomes and the workplace needs. By focusing on the supervisor's perspective, we provide valuable insights into one aspect of implementing effective and rewarding internships (i.e., supervisor preparation), thereby suggesting pathways for future improvements in these high-impact educational practices.

Keywords Work placement, Workplace relevance, Internships, Mentoring, Mentor challenges, STEM

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Introduction

Recent discussions, from several countries and disciplines, highlight the need for enhanced practical and career relevance in discipline-specific higher education (Abbott, 1988; Karimi & Pina, 2021; McGungale & Zizka, 2020; Norwegian Ministry of Education and Research, 2014; Scholz et al., 2004; Stofer et al., 2021; Varghese et al., 2012). These conversations emphasize that students should develop the ability to apply their content knowledge in practical situations and effectively communicate with others in their field. This dialogue underscores the importance of integrating real-world applications, transferable knowledge, and other career training experiences into academic programs. Relevance can be achieved through the curriculum in many ways, including via course-based research experiences (Gentile et al., 2017), course activities and assignments with relevance beyond the classroom (Balazs & Morello-Frosch, 2013), and work-integrated learning (WIL; Billett, 2009; McLennan et al., 2008). WIL is by definition focused on career relevance and readiness, and includes structured work activities as part of an educational curriculum. WIL is an umbrella term for experiences such as field work (Arcila Hernandez et al., 2023; Fedesco et al., 2020; Lei, 2010), sandwich courses (Busby et al., 1997; Santiago, 2009), and internships (or work-placements, work-practice, etc.; Costley, 2011; Kennedy et al., 2015; Velle et al., 2017; Wilton, 2012). Here we focus specifically on internships, whereby students engage in a temporary work experience, under the guidance of an experienced professional, beyond the classroom but as part of a formal curriculum. Of note, in Norway the programs in this study are referred to as work-placements, but to acknowledge the international nature of the journal's audience, we chose to use the term internships throughout.

WIL experiences have positive impacts on student motivation (Gardner & Belland, 2012; Kyndt et al., 2011), learning outcomes (Kennedy et al., 2015), and setting learning goals (Hole et al., 2022). Indeed, students in discipline-oriented programs want practical work activities to be added to their curriculum (Hole et al., 2016, 2018; Norwegian Agency for Quality Assurance in Education [NOKUT], 2014). Internships are one such avenue to accomplish this, but they are less often implemented in discipline-based programs than in professional ones (Billett, 2009; Scholz et al., 2004), and research on them appears limited. Specifically, prior work on internships focuses on the experiences of students and on formats more akin to internships within the context of higher education in the United States. Furthermore, there are few examples of investigations in Northern Europe (but see Velle et al., 2017). In response, the Norwegian government has called for an increased emphasis on investigating best practices in WIL in general, and internships specifically (Norwegian Ministry of Education and Research, 2014), recent calls that led to support for the work described here. Partly in response to these national priorities, integrating internships into curricula is becoming more prevalent in Norway (Costley, 2011; Kennedy et al., 2015; Velle et al., 2017), adding more internship-style programs to the range of similar experiences across STEM fields internationally. Using this new Norwegian context, we focus on the implementation and improvement of internships within biology and geology programs in higher education.

Course-based internship programs

Internship experiences (also called work-placements in some contexts) have a unique career preparation structure that involves students leaving academic spaces to engage in workplaces for a limited time (Aldas et al., 2010; Bogo, 2006; Edwards et al., 2004; Simons et al., 2012). As such, internships align pedagogically with experiential learning (Kolb, 1984), in which a student creates knowledge through direct experience and subsequent reflection (Hole et al., 2018). This work training during a student's formal education has numerous benefits. These benefits include learning new and transferable skills (Bennett, 2002; Parker & Morris, 2016; Scholz et al., 2004), faster study progression (Næss et al., 2012), and improved graduate employment rates (Silva et al., 2018). In addition, students gain a better understanding of future career options (Hole et al., 2018; Matthew et al., 2012) and how to apply their knowledge (Hole et al., 2018). They also develop professional judgment, practice, and identity (Hole et al., 2022).

Internship programs themselves involve *active learning* (Freeman et al., 2014; Singer et al., 2013), whereby students can apply their knowledge to real-life situations with guidance from a supervisor (Wurdinger & Carlson, 2009). This training can be particularly important for some professions that require practical skills that are not always covered in academic programs. Finally, internships address the need to integrate an autonomy-supportive teaching style, enabling students to feel more competent and independent in their motivation (Jeno et al., 2023). Due to these numerous benefits, internships are considered a "high impact educational practice" (Kuh, 2008).

Internships as situated learning

Situated learning theory posits that learning happens 'in situ,' which can be further explained as authentic contexts where learners must perform the work of a particular discipline (Lave & Wenger, 1991). Newcomers to a discipline need opportunities to socially construct knowledge

and benefit from communities of those more experienced in the field. Briefly, students need to observe and receive guidance from disciplinary experts while actively engaging in disciplinary work to build their own knowledge (Lave & Wenger, 1991). Situated Learning Theory has been repeatedly applied to learning in the sciences. For example, geoscience educators and researchers have applied Situated Learning Theory to the ways they teach and assess students and to the development of learning outcomes for their courses (Donaldson et al., 2020). In regard to internships, the combination of authentic learning experiences and guided mentorship make them a clear example of situated learning in practice.

Mentorship in internships

Internship supervisors have a critical role in helping students apply new knowledge to workplace contexts while also facilitating their social integration into this non-academic environment (Rose et al., 2014; Russell & Adams, 1997). Situated learning theory also emphasizes the importance of the community of practitioners that students can observe, learn from, and eventually incorporate themselves into (Lave & Wenger, 1991). Thus, the mentoring relationship between student and supervisor can dictate student learning outcomes, making effective mentorship a core component of a positive internship experience (Berg et al., 2020). That internship supervisors have both subject matter competency and mentoring competency is critical to reaching internship learning outcomes (McHugh, 2017; Narayanan et al., 2010). In reality, students have mixed experiences with their supervisors in Norway (Helseth et al., 2019) and beyond (Jaarsma et al., 2009; McHugh, 2017; Teng et al., 2021; Zehr & Korte, 2020). These discrepancies can be caused by supervisors' variation in mentoring experiences (Hegerstrøm, 2019; Wiggen, 2019), limited training in effective mentorship (Kristiansen & Wiggen, 2019; Zehr & Korte, 2020), and general deficiency in mentoring competence (Helseth et al., 2019).

The limited existing research about mentorship during internships primarily focuses on professional (e.g., clinical or technical; e.g., Gupta et al., 2008; Huprich & Rudd, 2004) rather than discipline-based programs, or on *research* mentorship (e.g., Stephens et al., 2017) rather than career and professional development (some examples include: Atkinson et al., 2015; Fifolt & Searby, 2010; Limeri et al., 2019; Tuma et al., 2021). These observations point to a lack of understanding of and support for supervisors' mentoring in internships, which is further evidenced by supervisors themselves who report a lack of mentoring training (Kristiansen & Wiggen, 2019; Zehr & Korte, 2020). Mentoring is complex and multifaceted, spanning development of knowledge (Hole et al., 2018, 2022), motivation and autonomy (Jang et al., 2009), professional community (Rose et al., 2014), and translation of skills (Ryssevik et al., 2011)—highlighting the need for research and resources to help supervisors navigate these critical relationships.

Research goals

In this work, we center the supervisors' perspectives to guide development of practical suggestions addressing those needs. Specifically, we explore supervisor experiences to understand the mentoring challenges they face, the resources they require, and their self-identified gaps in understanding of mentoring expectations. This research is motivated by several national calls to increase the relevance of our study programs in Norwegian higher education (Costley, 2011; Kennedy et al., 2015; Velle et al., 2017), and therefore, a need to better understand any barriers to successful internships. From this understanding, we can take informed actions to mitigate barriers and improve the overall internship experience.

Accordingly, our research questions are (1) what are supervisors' mentoring experiences and what are their concerns about mentoring? (2) What internship-specific challenges have supervisors encountered in mentoring students and what unmet opportunities do they see? and (3) What feedback- and evidence-based interventions for internships do supervisors propose to help meet those needs?

Through focus groups, we interviewed supervisors from a variety of workplaces in Norway who were mentors in STEM internships across several institutions. The immediate goal of this research is to use these insights to present concrete ideas that can be implemented in internships to support supervisor mentoring. We present our findings here, beginning with the concerns and motivations of the supervisors, then moving to the tensions and obstacles they encountered, and closing with proposed solutions and responses.

Methods

Research team positionality

Most authors have either been student participants in the programs studied or are employed by the programs' organizing institutions. These close ties to the internship programs, combined with the Norwegian government's educational priorities (Costley, 2011; Kennedy et al., 2015; Velle et al., 2017), sparked interest in improving the programs and using supervisor experiences to inform broader changes. The focus group facilitators knew the project aimed to gain insight into supervisor experiences for improving the internships and supervisor support. For each of the focus groups, multiple facilitators

connected to at least one of the internship programs were present.

Furthermore, a researcher in each focus group was local to the research site, allowing them to answer context-specific questions and increase participant comfort. As a result, the participants may have considered the researchers as insiders, leading them to share more openly (Kitzinger & Barbour, 1999); alternatively, that relationship may have led supervisors to withhold information (Ruppenthal et al., 2005). However, due to the in-depth stories we heard and the low sensitivity of the research topic, we do not expect this effect to be significant. The academic internship course instructors were not present during interviews to reduce conflicting power dynamics and to facilitate increased honesty. Finally, the researchers who coded the interviews were all trainees (bachelor, master, and PhD level) with direct program experience. This prior exposure to the internships provided unique insight to the coding process, improving analysis and interpretation.

In addition, having outsider perspectives provided important checks on the findings and process. This additional expertise and outsider perspective helped those who were deeply embedded in internship-organizing institutions to have a more critical lens on the programs.

Research context

The focus group interviews for this study were associated with three Norwegian institutions: the University of Bergen (UiB), the University of Oslo (UiO), and the University of Tromsø (UiT; also known as The Arctic University). One focus group was conducted at each of these campuses and involved supervisors in the respective campus programs. These internship programs were included in the study because of the commonalities of their course structures.

Specifically, the internship programs included in this study are part of campus-specific elective courses available for students enrolled in the STEM discipline-specific BSc degree programs. The internships at UiB and UiO focus on biology and the UiT internships focus on geosciences. These courses are elective courses available for students in the last year of their study program. They are structured with intended learning outcomes; examples include using discipline-based knowledge in an internship-specific context, acquiring sector-specific knowledge, and reflecting on the relationship between theory and praxis. Completing the courses requires a minimum of 250 h of work, with a minimum of 120–150 h consisting of relevant work at the internship while the remaining hours include on-campus seminars, written and oral presentations, and reflective essays. The three courses we study here are similar, but the institutions have differences in program logistics such as how students are matched to work sites, exact course learning outcomes, and syllabi. Each course has a primary university instructor, as well as organizational support from university administration. Descriptions of the development and structure of one of these internship courses are available elsewhere (Velle et al., 2017), and the other two courses adapted this model and thus have a similar structure. Critically, all the courses involve a triad of participants: students enrolled in the courses and engaging in the internship experience, the institution that prepares the students for the internship (via relevant curriculum and logistical support), and the supervisor at the place of the internship (Fig. 1).

Students can be placed at a variety of different internship sites, both in the private and public sectors, such as research institutions, museums, the consulting industry, local governments, and non-governmental organizations, among others. Student tasks can be laboratory-, field-, or computer-based, and students may regularly interact with scientists, engineers, consumers, or the public. The breadth of these opportunities highlights the reach of these internship programs and the potential relevance of this study's findings in a variety of work contexts.

Data collection

Focus group design We selected focus groups to collect supervisor perspectives, because as "structured eavesdropping" (Powney, 1988), they result in greater participant candor (Krueger, 1994). By gathering supervisors with others in the same role, the groups encourage deeper discussion (Kitzinger & Barbour, 1999) and provide a safer environment where the supervisors share more openly than they might otherwise (Barbour,

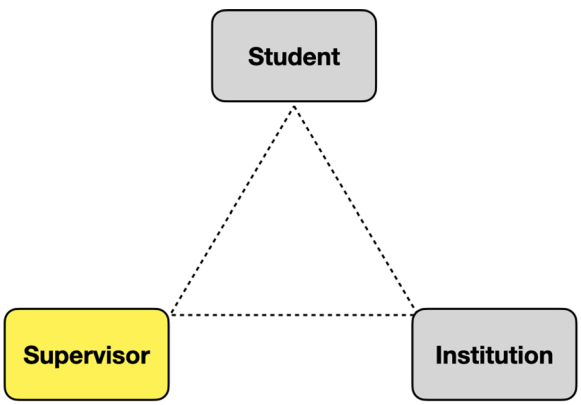

Fig. 1 Internship experience is determined by the working relationships between institutions, supervisors, and students. Here we focus on the supervisor experience, associated challenges, and suggestions for mitigating these challenges

2018). Focus groups excel at providing insight into *processes and experiences* rather than solely outcomes (Barbour, 2018). In addition, we were interested in dialogue between members and each participant's contributions to the conversation process rather than a single consensus answer, thus exploiting another strength of focus groups (Lehoux et al., 2006). As anticipated, the group facilitators observed interactive dialogue with participants building on and challenging the others' responses to reflect their unique contexts. These synergies can elicit more nuanced input from individuals (Belzile & Öberg, 2012), and indeed, we documented both shared and contrasting ideas. While focus groups can have quantitative limitations (Morgan & Krueger, 1993), we did not aim to make statistical conclusions or generalizations in this study, meaning that limitation is not a concern.

Group participants We conducted three focus group interviews, with supervisor participants recruited by the respective course administrators at each institution. Specifically, each course has a designated staff member who maintains contact with all the off-site supervisors. This pool of supervisors was contacted by each course administrator by email, with specific information about the nature of the study. We then worked with a self-selected group of supervisors. All focus group participants were volunteers, which means that certain perspectives may not have been captured in the data. In addition to the interviewer, the UiB focus group included eight supervisors from six workplaces, a student technician, a teaching technician, and the study administrator; the UiT group consisted of four supervisors from four workplaces and two student technicians; and the UiO group involved five supervisors from four workplaces, a teaching technician, and two student technicians.

Focus group implementation Recruitment and data collection—including all study information, protocols, and the consent form—were notified to the System for Risk and Compliance at UiB (RETTE), and all data were de-identified prior to analysis and distribution. We followed national regulations for the use of human subjects in research. Specifically, all participants were given written and electronic information about the voluntary nature of the research, and each gave their consent to participate anonymously and confidentially. We conducted and audio/video-recorded the group interviews during several-day site visits at each location. These discussions were 60–90 min in length. Each semi-structured session (Murphy et al., 1992) began with a 30-min question-and-answer period, followed by a more informal discussion. Lunch was then supplied, where—unobserved for the study—participants could decompress and further unpack the discussion topics.

Focus groups were originally conducted in a combination of Norwegian and English as many of the participants and all of the facilitators were fluent in both languages. However, for communication to a wider audience, we have translated all quotes presented in this publication that were originally in Norwegian into English. Because of the bilingual nature of this research team, we were able to complete this task while maintaining as much of the nuance of the original language as possible. Still, all translation is an approximation and so the quotes presented here may not be exact. Statements made in brackets indicate edits made to the quotes for purposes of clarity, identifying a synonym that is more appropriate than a direct translation, or improving the grammar of a statement. In all cases we focused on accurately portraying the participants' meaning.

In this study, it was important to acknowledge the authentic learning experience, and the role of the supervisors as disciplinary experts, in keeping with Situated Learning Theory (Lave & Wenger, 1991). Specifically, this study aims to increase the knowledge of the situated learning from the perspective of the internship supervisors. These individuals meet the students on site and introduce them to discipline-relevant work in their specific internship, and this role was addressed in the design of the focus group protocol.

The focus group protocol was constructed a priori during a series of team meetings, specifically to address our research questions. The protocol consisted of several question stems and suggested follow-ups, including:

1. Share your general experience as a workplace supervisor. What do you have your student interns do when they work with you? Can you give a specific example? Do others in the room feel the same or differently?
2. Can you share what has worked well? What do you feel you have done that has made this work well? Have others in the room had the same or different experiences?
3. What could be better for you about this experience? Can you identify specific challenges to you in being a supervisor for a student intern? Have any others experienced something similar?
4. Complete this sentence: One thing that would help me be a better supervisor is _____. Do the rest of you agree or disagree?

We facilitated a collegial atmosphere by opening the discussions with introductions to highlight both shared experiences and the range of backgrounds present. During the focus groups, we asked the above questions with pauses afterward to provide time for processing, as is

best practice (Barbour, 2013). These discussions provided opportunities for supervisors to share personal experiences, promoting interaction rather than interviewer control (Bloor, 2001). Participants expressed gratitude for this approach, further illustrating that our groups were supportive spaces.

Data analysis

To prepare for analysis, we transcribed the video recordings, generating a transcript during a first pass of the recording and correcting errors in a second pass. Personal information was de-identified during this process. We used qualitative content analysis (QCA) to analyze the transcripts. QCA is an analytic technique suited to addressing our research questions because it facilitates connecting concepts (denoted codes) to construct patterns and themes (Hsieh & Shannon, 2005; Saldaña, 2013). We coded the transcripts using an inductive process to identify ideas salient to the supervisors rather than comparing content to an existing framework (Charmaz, 2014; Kelle, 1997). We managed and coded transcripts using the Dedoose software package (Salmona et al., 2019).

We coded in multiple rounds. Three individuals each coded the same transcript independently, then developed a preliminary codebook of approximately 20 codes through consensus coding (Harry et al., 2005; Stemler, 2004). The coders then applied this codebook independently to a second transcript, coded to consensus afterward, added codes, and refined the codebook. This iterative process was repeated for the final transcript, and codebook changes were re-coded in earlier transcripts.

After coding completion, we identified patterns in the data aligned with our research questions. We sought a breadth of views rather than a single story (Anders & Lester, 2015; Riley, 2017), and while code frequency counts provided some initial guides (Silverman, 2006), we did not attach meaning to the actual values (Barbour, 2001) out of a concern that quantification would be misleading.

Considerations of methods and scope

Prior to an interpretation of our focus-group results, some biases and caveats are warranted. First, our data are restricted to the input of supervisors working in STEM fields, limiting extrapolation to other disciplines. However, much of what we will present seems to concern global, rather than STEM-specific, experiences and perspectives. Similarly, the Norwegian context may not be representative of other internships in other cultural contexts. Finally, our focus groups likely involved the most committed supervisors in our different populations–individuals who were willing to take a half-day off work to travel locally and volunteer their time to this effort. Supervisors who are less enthusiastic about this role may have faced legitimate challenges during the internships, but these perspectives may not be represented in our data.

Results

Summary of codes

As a result of the iterative consensus coding process, we developed a final codebook consisting of 24 codes. Codes spanned many concepts, including supervisor–student communication, student experiences, internship logistics, challenges, and solutions (the complete codebook can be found in Supplemental Materials). In constructing themes, we identified three broad categories of codes. The first category centered around the concerns and motivations of supervisors, including how those concerns fed into their motivations. The second described the variety of obstacles and tensions supervisors encountered in internships, and the third involved actionable solutions proposed to respond to those obstacles. These broad categories align well with our original research questions and focus-group questions. Our results present each of these groups and summarize the common themes within each.

Supervisor experiences and concerns

The internship supervisors were broadly invested in the success of their students and were motivated to create as positive of an experience as possible. This led to lively discussions regarding improvements to internship programs and support that is necessary to achieve these goals. Many supervisors brought up concerns regarding the internship experience that underscored that they were trying to be effective in their roles. The concerns coalesced around two primary ideas: whether they were exploiting students and whether the internship was rewarding. Supervisors describing their concerns also pointed to how their mindfulness of student well-being directly motivated them to become effective mentors.

Student exploitation Some of the supervisors commented on labor practices and the structure of the internship as a reason they wanted to be good supervisors. As one participant described, "we are making a sensible effort so that we are not simply exploiting the students… because what we hope for is that they will be inspired and informed." This statement both identifies a concern they seek to avoid and connects that concern to their motivation as a supervisor. Another supervisor drew on their personal experience in another country,

> *"In [other country], it's a real problem actually, we have like a three-month, four-month [internship]*

that's for course credits where they don't get paid, and that's quite common and something I don't particularly like, and I don't think the students get as much [out of the experience] as they should."

Through comparing institutional contexts, this supervisor saw how internships can operate, making this potential pitfall a salient concern. This same supervisor elaborated on how this concern affects them, explaining, "…so I find myself being very worried about [exploitation] and making sure, so I'm maybe overcompensating." They convey the importance of this exploitation concern, even going so far as to notice it may be so strong that they put excessive effort toward being a positive mentor.

Rewarding experiences Another concern that arose was whether the internships were rewarding for students. Though this sentiment can be connected to exploitation as indicated above, this was considered a distinct concern as the supervisors focused more on student benefits from the experience rather than on how the supervisors might extract labor without providing fairly in return. Some of the ways supervisors viewed this concern included student learning outcomes and work relevance.

As one supervisor expressed, "some of the work that really works well for us is something that… also doesn't help them so much." Another added, "the question is, are we providing enough [content knowledge]? That's our challenge." These supervisors point to a desire to provide students with work that develops them and provides needed competencies. They see the internship not just as an opportunity for the employer to gain useful labor, but also as something that must provide students with useful learning opportunities. A third supervisor elaborated that this desire was "a clear goal, something concrete to work towards." These supervisors point to concerns about work relevance-specific learning and professional development objectives. They want the students to be in a better place at the end of the internship than when they started, and supervisors seek the internship's relevance to help them get there.

These concern and motivation examples illustrate two of the major worries supervisors have about the internships—unjustly asking too much of students and not providing enough reward to them in return—and how these worries drive them to improve the programs. One supervisor connected the two together, observing,

"It was really nice for us to have [the student] because she could contribute to processing and conducting all the measurements on the cores, and we also got to see that she was a potential candidate for a summer job. So we offered her a summer job with us, which was [both beneficial for] her and enjoyable for us."

In making the internship both non-exploitative and rewarding, the program can benefit both parties, and this was a compelling goal. As a result of these concerns and motivations, the supervisors desired to identify the challenges they face that stand in the way of them addressing these concerns. These mutually beneficial motivations were important to observe as we relied on the supervisors to propose solutions to the challenges they encountered.

Challenges supervisors encounter

With the supervisors motivated to make the internships a good experience, another area we studied is the obstacles supervisors encounter when trying to act on those concerns. Three types of challenges were most apparent: difficulty tailoring the internship experience to the individual students, limitations from the academic course structure, and insufficient communication during the program.

Tailoring the experience As described above, the supervisors wanted to make the internship rewarding, and they attested to how personalizing the experience to the needs and competencies of the students is a critical part of that. However, they found this was challenging, and obstacles ranged from high-level project selection down to identifying specific tasks and learning objectives.

A supervisor conveyed their experience with internship project selection saying,

"At our place, it's difficult to provide a project for them to work on. [Workplace] has quite substantial tasks, and we can't just assign a student to write a pollution permit… there are limitations on what they can be allowed to do with us."

Despite a desire to provide an appropriate space for students to work, the limitations of what students were capable of or even allowed to work on could make it difficult for supervisors to accomplish that task. This challenge illustrates how discrepancies between student qualifications and the demands of the workplaces can make tailoring the student experience difficult. In addition to this mismatch in qualifications, their unpredictability was also an obstacle. Another host expressed,

"I have to say that there's a lot of variation in who you get. They are incredibly different individuals with different motivations, different interests, different backgrounds, etc… So, there must also be an element of adaptation, improvisation, etc., considering who you actually get. If you can at all."

They testify to the importance of flexibility in internships, but they also acknowledge the demands placed on

them by the inherent fluctuations in incoming students and that it may not even be possible to respond with sufficient agility. The lack of skills alignment and stability prevents them from tailoring the experience to be rewarding, despite their desire to do so.

Program structure Another challenge the supervisors faced was connected to the WPs being a partnership between the workplaces and academic institutions, resulting in limitations on supervisors from the academic structure and focus of the institution. The format of the WP reduced work opportunities, and those opportunities did not always align with the focus of the workplace. One of the supervisors explained the impact of the academic internship context on the work they can offer,

> *"So when planning the internship, we have tried to structure it with specific tasks… However, sometimes they say things like, 'Oh, on Monday, I can't come until after lunch because I have another course.' Suddenly, it becomes a bit of a puzzle to schedule them… because they have other courses or commitments that can disrupt their availability… These external factors can also affect the feasibility of carrying out tasks and the presence of internal staff members who can assist. It's inconvenient when they engage in other parallel activities."*

Because the internships are set up as academic courses taking place during the term, the students' schedules are built around their simultaneous engagement in other courses, and this directly affects how they are able to engage with the internship work. Some of the internship courses are organized in parallel with other courses, leaving it up to the student and internship host to find times that fit both calendars. Others are organized as set weeks in the calendar, predefined by the university, and thus with less flexibility. This unpredictable availability, and other student obligations, directly limits the types of tasks they can engage in, and this frustrates some of the supervisors.

In addition to the day-to-day logistics limiting work, the overall length of the internship was a barrier too. Supervisors recognized that the timeline of the internship is set by the academic calendar because the program is implemented as an academic course during the term. However, they noted this sometimes hurts the work experience. As one supervisor put it,

> *"Taking in a person for just one week can quickly become demanding because if something happens… the student is not at that level of being able to contribute in handling a situation like that… We're paying a lot for this [project], and we need to get it up and running, and there would be limitations on what the student could be involved in."*

Supervisors highlighted how the limited length of the experience prevents the students from contributing to significant projects, particularly those with urgent timelines the workplace has invested in. Another participant also asserted the limited timeline inhibited work opportunities, "A lot is happening towards the end of the internship period. Ideally, for us, the internship would have been a bit longer." They highlight the misalignment between the workplace and academic calendars and that the limited time of the internship reduces both the number of tasks students can work on and the benefits the supervisors can receive.

In addition to work timing during the days and the term, another aspect of the internship structure that was an obstacle for supervisors is how the professional–academic partnership results in misalignment of institutional priorities. As one supervisor related,

> *"I think our [workplace] focus is a little bit disjointed from the university… so I feel like sometimes, if we have too many botany students, we don't really know what to do with them actually sometimes… usually what we need people for is terrestrial zoology and I think that's something that sort of doesn't really have that much of a focus in the research groups in [specific university]… Basically it means that for pretty much every single project there is one faculty member who is the person who is the official contact person for [specific institution], but actually they aren't necessarily the right academic background for that."*

They note how, even though the internship program is designed to prepare students with practical career skills, the difference in training program focus between the institution and the workplace results in challenges: the students' expertise does not always match the work the supervisors do, and the faculty at the university working with the internship course are not in a closely related field. The supervisors express how this makes it difficult for them to mentor and provide relevant experiences for the students, in addition to how that makes the supervisors' jobs more difficult. Together, the misalignment of workplace–institution priorities and the challenges of meshing workplace timelines with academic ones illustrate how WP structure can be an obstacle for supervisors.

Communication and feedback Supervisors also expressed how a lack of communication at all stages of the program inhibited them from improving the internships. Lack of communication centered on the hosts receiving insufficient information, and in the triangle

of the three parties involved in the internship programs (supervisors, students, and institutions, Fig. 1), both lines of communication involving supervisors stood out.

An aspect of supervisor-program communications that supervisors emphasized as a challenge is the lack of clarity on program objectives. As one supervisor elaborated,

> *"I am uncertain about whether we are relevant or what could be done differently. I might be missing a clear goal, something concrete to work towards. Maybe they could… give us a specific task, rather than just aiming for the 'internship experience.'"*

They mentioned how they feel they have a lack of guidance from the institutions on what the program goals are for the student. The supervisors notice a lack of clear communication regarding learning objectives and instead feel left to fend for themselves toward some vague "internship experience," wondering whether they are even relevant to the experience.

This perceived lack of guidance also extends to dynamics between supervisors and students. Again, highlighting a lack of information, another supervisor testified,

> *"What's lacking and what I hope will come out of this is some information: What is expected of us, what can we expect from you as a student, what formal role do we have, and what can, well, a lot of practical aspects surrounding it… Are we completely off track, or perhaps are the other companies the ones off track? Are we hitting the mark? Are the students satisfied afterwards?"*

The insufficient communication between students and supervisors, especially before the internship begins, manifests as unclear expectations and a lack of feedback. Without this coordination, supervisors state how mutual roles in the mentoring relationship are unknown and how supervisors do not know if they are meeting the needs of students. This lack of expectations is underscored by the hosts not receiving adequate information in both directions—from institutions and from students.

Proposed responses and solutions

Supervisors proposed a variety of concrete solutions to respond to the tensions and obstacles they face in the internship. Although their concerns spanned many areas including program structure and customizing the internship, a broad theme we found is that many of their proposed solutions focused on communication to address these challenges. As discussed above, the three parties in internship programs form a triangle of sorts (Fig. 1), and supervisor solutions tend to focus on one of the three primary lines between parties: institution-to-supervisor, institution-to-student, and supervisor-to-student. Institution-to-supervisor communication solutions included the institution showing more transparency about the incoming students and the institution providing supervisors with concrete training and resources. Institution–student communication proposals often centered on internship organizers working with students to share detailed information on workplace options to facilitate good expectation matches. Finally, supervisor–student solutions included both setting collaborative learning objectives and engaging in mutual feedback processes.

Clearer up-front communication from institutions to supervisors A common solution supervisors proposed was improved communication to them from the institutions, particularly before the internship begins. They wanted to set explicit expectations but found limited communication a barrier, and they saw providing information to supervisors about the incoming students as a useful mechanism to address this. Supervisors saw the internship organizers at the educational institutions as the critical part in facilitating communication.

Supervisors pointed out how knowing more background on the students before the internship started would help them prepare and tailor the internships to fit the student. As one supervisor straightforwardly remarked, "It's just a question I got from my management, like 'do we know anything about these students?' And I just said, 'no, they're coming on Monday at 9.'" As discussed earlier, supervisors have a desire to make the internship rewarding for students and to make the experience rewarding, but a lack of communication limited what they could accomplish.

Supervisors proposed increased clarity and expectations from the institution's internship organizers regarding competencies and expectations. In response to being asked if they would find it helpful to know pre-internship if their student could use Excel or have other skills, two supervisors imagined:

> *"[Supervisor1:] Whether they can or not, yes. It's important to write it into the [internship matching] assignment that 'this is the minimum requirement'… [Supervisor2:] We have online resources so that's also something we can consider if we need to prepare the students or give them a pre-task to refresh their Excel skills or something, so thank you, we'll take [knowing their skills]."*

They suggested that the internship organizers (1) communicate student competencies to the workplaces so

they can prepare adequate resources and projects to bring the students up to speed and (2) be explicit with the expected skills on job postings so workplaces have clarity on incoming skills. As suggested above, this could be facilitated by the educational institution through clearer job postings and greater transparency to the workplaces, but other supervisors also proposed that the students could play a role:

> *"[Supervisor1:] It would be really nice if I could just create a form, especially if you provide some feedback on what you would like to include in that form, like '[students] fill this out and send it to the [supervisor organization] along with your introduction'…*
> *[Supervisor2:] A bit like a CV, yes, like their work experience, what have they done before, what do they want.*
> *[Supervisor3:] Yes, and what they want, that's actually the most important."*

They point to the students providing the information directly as an additional avenue for improved communication. Skill competencies were highlighted again, but a unique advantage of the students providing information themselves is that they can communicate their specific motivations for the internship—information that could help the supervisors.

Supervisor training and resources The other facet of institution–supervisor communication the supervisors pointed to is institutions proactively providing adequate support resources to the supervisors. Given how supervisors felt there were a variety of mentoring responsibilities expected of them, this would both help address gaps in supervisor competencies and streamline their mentorship by making information easily accessible. However, as some hosts noticed, there is not a shared idea that all supervisors even play a role as mentors:

> *"[Supervisor1:] We function as mentors, and that role is very important, I think. And valuable.*
> *[Supervisor2:] But I think maybe that could be specified a bit more of what we are. A [supervisor] is someone you're with and you live your life separately, but in [this WP] context, if you're with a [supervisor] you have a mentor. So, to state that: 'I am your mentor, or your guide while you're here.' I think that maybe... they should use those terms, and it's the same for everyone. Then there are also consistent expectations."*

It is difficult for institutions to provide adequate mentorship resources to supervisors if the supervisors do not even see themselves as *mentors*. They claim that this common language is not used within the program and that doing so would help set common goals around mentoring. This is only the first step in supporting supervisors' mentoring, however, and they attested to the importance of resources tailored to their unique needs.

Respondents suggested institutions collect feedback from supervisors to identify what internship expectations they feel least prepared to meet. These unique needs will vary across contexts, and in our group of supervisors the most common expectation they needed support with was writing letters of recommendation. One supervisor remarked, "I haven't written any [references] before… So, yeah, I think it would be helpful to know what to write." To train them on how to write references, other supervisors recommended the educational institutions provide them with a template of questions sufficient for writing one, "that could be included in a [training] module where you can provide quick feedback, and then the reference comes out as a standard recommendation."

This highlights a trend of supervisors desiring resources and information provided directly to them—as in the training module suggested above—rather than expecting the supervisors to search out the information for themselves. Eliminating the search eases their responsibilities and provides more time to focus on students. As one supervisor asserted,

> *"When we are contacted by educational institutions, the link to this [resource] should be included directly because I won't remember to go there and check. So, the information needs to come to us."*

Because remembering where internship program resources are and when they need to reference them is not seen as a typical part of their job responsibilities, institutions proactively reminding and providing those resources can help ensure supervisors have the tools they need at the right times.

Institutions communicating workplace expectations to students Supervisors also highlighted a second line of communication in the internship program triangle that could be improved: information from the internship organizers to the students. Beyond the supervisors knowing more about the students, they also wanted the students to know more about the workplaces. As one supervisor related,

> *"If there was an info module that introduced students to the companies early on, you could sell the company a bit... If you receive that information when you're about to start the course, you have very little time… But if you're introduced to the course early on, so that you become curious, and the information about previous companies is easily accessible… then maybe you'll get even more interested professionals. At least they know what*

they're getting into."

Another supervisor added, "those modules could be something like 'okay, you should experience so and so many hours of meeting activities in companies', or organizational life." Tapping into their concerns about program structure and expectations, the supervisors counter that providing easily accessible information to prospective interns can set work expectations up front before students are even matched. This may even have the added benefit of attracting students who feel interested and motivated to engage with the workplace.

However, the supervisors acknowledged that internship organizers can only provide this information to the students if the workplaces have made that background clear. To aid in this, supervisors suggested,

> *"A simple questionnaire for companies: Is it practical work or office work? Those kinds of things that we can check off… It's advantageous for both us and them to have some idea of what they're getting into."*

By having a structured way of schools collecting the important expectations like hours, work location, and responsibilities before the internship, organizers can ensure that information is available to be provided to students rather than a haphazard collection of pieces that may be insufficient for students.

In summary, to improve communication, supervisors emphasize three key strategies. First, provide more information about students to workplaces by setting clear competency requirements in job postings, provide student backgrounds and skills to supervisors, and allow students to directly communicate their work histories and motivations. Second, provide structured discussion times for students and supervisors to exchange feedback, with an alternative anonymized avenue for feedback collected by the institutions. Third, provide students with comprehensive pre-internship information, like backgrounds and expectations of the workplaces. This approach may require the institutions to seek out the needed information from supervisors before the internship.

Increased feedback In the third and final line of communication—that between supervisors and students—supervisors highlighted student feedback as a useful way for them to improve the internship experience. This reflects their desires to tailor a rewarding experience for students and illustrates the high regard with which they hold student voices. In response to the idea of receiving direct student feedback, one supervisor said,

> *"I think that's important because we actually receive very little feedback from the students. In a large company, it might be that somewhere up in the system, at some point, some form of feedback has been given, but for us who have actually been with the student, there is no direct contact with the student, so I think that could be much more useful."*

As another supervisor attested, "it's a bit like we're trying blindly and to the best of our ability… but it could be that we've misunderstood." They recognize that, especially with bureaucratic structures that can be present in larger workplaces, they have limited guidance, and an explicit structure for collecting input from students would be helpful. Holding a mid-WP and post-WP discussion between a student and their supervisor was a popular solution, with supervisors emphasizing how helpful feedback meetings can be. They recommended some specific questions to ask students, including "Are they satisfied? Is there anything they found negative? Is there anything they found positive?".

However, an important caveat supervisors identified is the power dynamic that can be present in such supervisor–student meetings. Students may perceive such discussions as high-stakes or loaded with one-way criticism. One supervisor testified,

> *"We have the mid-term evaluation with them, but it's possible that there are things they don't want to say directly to us… They might be more comfortable sharing those things with [internship organizers], so it would be helpful to receive general feedback from [the institution]. Not necessarily mentioning specific students."*

To mitigate the power differential, supervisors suggest the institution solicit feedback. This allows students to offer feedback without fearing retaliation from the workplace. By involving all three parties in the communication triangle, the institutions can de-identify this feedback and provide overarching themes to workplaces for improvement. Supervisors also suggested having these conversations outside of higher-stakes evaluation meetings, and including student reflection questions, informal interviews, presentations, and surveys.

Supervisors saw this proposed feedback and evaluation as bi-directional. They said it was an opportunity to give feedback to the student "so that they actually receive an assessment" that is concretely documented. Supervisors remarked this also has the added possibility of being passed on to the educational institution, as well for potential grading uses. In the other direction, supervisors viewed such a discussion as an opportunity for the students to shape the internship experience and inform the supervisors how to improve the program. By baking such feedback opportunities into the structure of the internship, the supervisors saw opportunities for internship

program improvement, student growth, and integration into the academic side of the program.

Concrete and collaborative learning objectives Another area of student–supervisor communications solutions the supervisors proposed related to setting internship program learning objectives. As addressed earlier, supervisors found a lack of expectations a barrier to mentoring, and learning objectives were one way they believe that could be addressed. As one supervisor commented, "I am… uncertain about whether we are relevant… I might be missing a clear goal, something concrete to work towards." Another supervisor recommended having "learning objectives that [students] should achieve while they are with [the supervisors]." To facilitate a more rewarding experience, there are several priorities supervisors brought up when discussing how to develop these learning goals.

First, supervisors emphasized student agency to create what is valuable to them. As one supervisor put it, students ought to be able to,

> *"Start by planning where to drive and where the different points are, the most efficient route. It's very simple work, but we can see that they find it very rewarding because they get to plan their own days."*

With clear work expectations communicated pre-internship, they envision a program where students have the freedom to pursue what is compelling to them, and they imagine that driving the project can also be a skills development opportunity for the student. To equip and motivate students to do this, however, the supervisors recognized that they need to show students the vision behind their work and how it is compelling. One supervisor related that it's possible "students don't fully see the joy" in their work, because by the time, the impacts are visible it may be "three years since they worked on it." While this is a fundamental limitation of the current internship timing, structure, and project pace, in response, they suggested that supervisors,

> *"Can create something that demonstrates the value of what they're doing, even if they don't see it when they're working on it internally. I think that could help them understand that they are actually making a valuable contribution."*

As a result of seeing how their work fits into the bigger picture, students could be motivated to drive their work forward and have the background to see what directions would be most impactful.

Beyond simply allowing students to contribute to the internship objectives, a second facet supervisors emphasized is the importance of supervisors collaborating with and supporting the students in setting these objectives. Rather than setting the students loose to find their own path and expecting them to produce output for the workplace, supervisors stated it was also valuable to consider,

> *"In addition to all the things they do for us, it's also like: 'what can we do for them?' So we often sit down and discuss where they want to go, how we can help them, and which people we can connect them with… Since they're associated with a project, there are opportunities within the project if they want to continue and contribute their own ideas. So it's a bit different from if it were like: 'We just need someone to do this and that.'"*

They emphasize that while students ought to be centered in goal-setting, the workplace has a responsibility to go beyond simply taking in student labor and instead really *invest* in the students to support them in making their goals. They envision the process of setting and reaching goals as going both ways. As the supervisor above describes, some of this support includes talking with students about their desires and needs; but another supervisor adds this could also take the form of contextualizing the student's education, so they have the background they need to chart a path forward,

> *"One must consider this as an opportunity for the student to see what their education can actually be used for. And if they find out within a week that 'this is not what I thought I would be doing,' then that's also good."*

This is a clear movement beyond the supervisors seeing the students as a source of output; rather, it is perfectly okay for the student to decide the field is not for them. This collaborative approach to setting concrete learning objectives with the core aim of developing the student was the hallmark of the supervisors' proposals.

Discussion

We recognize that this study, and the associated implications of our findings, have limitations. Our findings are context-dependent, and best reflect the nature of student internships across our three Norwegian institutions. Any recommendations derived from these findings will also be constrained by context and feasibility. However, much of what was revealed in our focus groups is likely applicable beyond our study system. Furthermore, our focus groups consisted of non-random, voluntary groups of participants, a limitation that may affect our conclusions and limit our ability to extrapolate from these findings. The groups were also not all the same size. Due to ethical

considerations involving the use of human subjects in research, any work of this nature conducted at our institution is by definition voluntary and non-random. In future, to increase access and broaden the diversity of our participants, we could broaden our recruitment efforts, meet with hosts on their sites, and administer online surveys to our complete pool of hosts. Finally, some of our focus group participants were pre-acquainted, which can provide a more comfortable environment to collect complex social data (Bloor, 2001; Brown, 2015). However, we recognize that this also could have impeded some participants from communicating freely, especially in situations where there were actual or perceived hierarchical differences.

In general, internships are considered a high-impact practice, helping students explore career interests, apply academic learning, and develop a professional network (O'Neill, 2010). Universities support students in work-practice experiences to enhance learning and student employability, and provide students with real-world experience (Caddell & McIlwhan, 2019; Hole et al., 2018; Velle et al., 2017). These experiences also benefit the university by strengthening community connections, whereby area employers represent a critical facet of the community, and improving its reputation (Weible, 2009). Finally, employers in the community benefit from these experiences by gaining access to a pool of skilled and experienced potential employees (Weible & McClure, 2011). Given these benefits, there is clear value in supporting both students and their supervisors during an internship. Here, we focus on the supervisor experience as an avenue for improving the impact of internship programs for all parties involved.

Specifically, this study presents an analysis of the challenges, needs, and feedback of supervisors managing students in internship experiences. We primarily focus on addressing our three research questions involving supervisor experiences and concerns, tensions and challenges supervisors encounter, and proposed responses and solutions.

Supervisor mentoring experiences and concerns

The participating supervisors are clearly invested in the success and well-being of their students, and this shapes the concerns they feel are most salient. Throughout their internship mentoring experiences, their primary concerns are twofold: avoiding exploitation of students and ensuring that the internship is rewarding and beneficial. Exploitation concerns arise from instances where students may be used for labor without adequate compensation or learning opportunities. On the other hand, ensuring rewarding experiences involves providing meaningful and relevant work that contributes to the students' learning and professional development. Supervisors strive to make the internship experience both non-exploitative and beneficial, thereby creating a mutually advantageous environment. Furthermore, the more "meaningful" supervisors can make the work, the more authentic that experience becomes for the student. Engaging in the actual work that professionals do is an important element of situated learning theory (Lave & Wenger, 1991) because it allows students to experience what true membership in the professional community feels like.

Tensions and challenges supervisors encounter

Supervisors face several challenges in creating effective internship experiences. These include the difficulty of tailoring the internship to individual student needs, constraints imposed by the academic course structure, and inadequate communication during the program. Tailoring experiences to suit diverse student backgrounds and skills is a significant challenge, often hindered by the limitations of what students are allowed to do or capable of handling, and what the supervisor knows about the student beforehand. The academic structure of the internship also imposes restrictions, as students' other course commitments can disrupt their availability and the work they can engage in. Finally, communication issues, both in terms of receiving sufficient information and setting clear expectations, hamper the effectiveness of the internship. While there was high-level alignment across stakeholders to enable student success, in practice the differences in skills, logistical expectations, and communication styles introduced challenges in internship implementation. Supervisors described these tensions impacting them by fueling feelings of uncertainty and lack of preparedness; however, through their mentoring experiences supervisors still see all of these areas as opportunities for improvement.

Proposed responses and solutions

To address the above challenges, supervisors' feedback suggests interventions primarily centered around enhanced communication and setting clear expectations. They recommend better upfront communication from institutions to supervisors, providing detailed information about students and clear guidelines on program objectives. Supervisors also call for structured feedback mechanisms, both from and to students, to better understand and meet their needs. In addition, they emphasize the need for collaborative setting of learning objectives, involving both student input and supervisor guidance, to ensure that the internship is

aligned with students' educational and professional aspirations. To practically implement such suggestions, best approaches will depend on the program context. In the following section, we propose a variety of specific strategies along with considerations for how each strategy connects to the supervisors' feedback.

Implications of findings

Our findings highlight the importance of clear communication, tailored experiences, and a focus on mutual benefits in supervisory roles within internship programs (Fig. 2). In keeping with the inclusion of internships in the broader field of Work Integrated Learning (WIL), these recommendations echo, to some extent, those of similar WIL investigators. For example, work by Jackson et al. (2017) and Winchester-Seeto et al. (2016) emphasize the need for clear communication and establishing concrete learning outcomes. By addressing these key areas, internship supervisors can likely create more effective and rewarding work-practice experiences for their students.

Clear communication Several studies have emphasized the importance of clear communication in supervisor–mentor working groups. For example, Lejonberg and Tiplic (2016) found that mentoring that is characterized by open communication and trust, positively impacts mentees' self-efficacy and intention to stay in their positions. Ismail et al. (2009) further supported this, showing that supervisor communication in training programs significantly influences employees' motivation to learn, which in turn affects their attitudes and behaviors. Tepper (1995) and Mohammad et al. (2019) highlighted the role of communication strategies in maintaining stable relationships and fostering group commitment, respectively. These studies collectively underscore the critical role of clear communication in enhancing the effectiveness of supervisor–mentor working groups. To improve challenges related to communication, our focus-group participants recommended that institutions provide the supervisors with more information about the incoming student(s), their existing skill sets, and relevant coursework. Internship courses can accomplish this through, for example, CV-writing exercises in which students "package" their skills and experience for future supervisors. To simplify this process, a standard form could be used in place of a formal CV, whereby students are asked to complete information about prior work experiences, interests, coursework, relevant skills, and expectations, and then share this form with potential supervisors. Many focus-group respondents indicated a desire for mentor training and discussed several options for providing training resources. These options range from the simple to the more complex. The bespoke nature of internship programs warrants tailored resources. Establishing a mentor-training program with static or dynamic online resources, or courses available in person or online, synchronously or asynchronously, may be optimal.

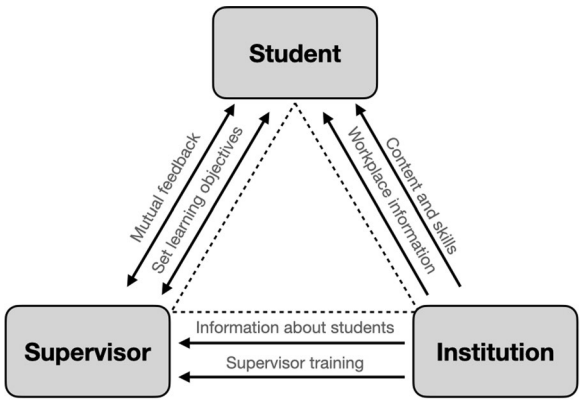

Fig. 2 Communication between supervisors, students, and the institution was repeatedly highlighted, and supervisors had several concrete suggestions for improving communication

The institutions can also help by giving students information about the workplaces, or by pointing students to relevant information online. Furthermore, by communicating to students basic expectations, such as the time commitment expected, working hours, and workplace norms, institutions can help ensure a better internship experience for everybody.

Much of the conversation around communication centered on student–supervisor communication. Clarity was often emphasized, whether in relation to providing students with information about the workplace or discussing mutual expectations. There was general agreement that collaborative goal setting, within the existing constraints of the job posting, was desirable. Supervisors also highlighted the importance of regular meeting times. Even a short, 10-min check-in can eliminate confusion about expectations and improve the overall experience. An onboarding meeting to review backgrounds and expectations, and then agree on goals for the work and learning objectives (including communication plans and correct contact info), can minimize confusion and complications further on.

Finally, almost all our conversations emphasized the importance of consistent two-way feedback—between students and institutions, between institutions and supervisors, and critically, between students and supervisors (Fig. 3). In support of this claim, we can take inspiration from the clinical-sciences internship literature, e.g., the reviews of Scott et al. (2000), and Callahan and Watkins (2018) who call for "an evidence-based approach to training." For a specific example, O'Donovan et al. (2011)

recommend the implementation of standardized formative feedback, a practice Cummings et al. (2015) call *essential* to effective supervision. Establishing a practice for such feedback can easily be incorporated into supervisor training.

Tailored experiences To tailor the experiences, the hosts seek more information about the students at an early stage of the relationship. They want to know more about the students, such as which courses they have completed and what skills and content knowledge can be expected from them. In addition, they ask for additional information about the students, such as other relevant skills and competencies obtained from other part-time positions, hobbies, etc. that might prove relevant to specific tasks the students could perform at the workplace. This can be tailored by the CV, or through a short conversation between the supervisor and the student prior to the start of the experience. Institutions can help ensure a good fit between students and hosts by communicating information about the students to the hosts, and by attempting to align student competence with available internships.

Focus on mutual benefits Recent studies have consistently highlighted the mutual benefits of supervisor–mentee teams. Kalpazidou Schmidt and Faber (2016) found that mentors in a pilot program for female researchers experienced professional development and personal satisfaction complementary to the benefits realized by the mentees. Similarly, Beltman and Schaeben (2012) identified altruistic, cognitive, social, and personal growth benefits for mentors in a university-wide peer mentoring program. These findings align with the present work, which highlights how the internship hosts are concerned with providing a rewarding experience for the students, and at the same time meeting the specific needs of the project at the workplace. While some of our informants say they are concerned that the students will spend too much time doing less rewarding, routine work, we note that this might be the first time students encounter such work, and they may not find it so "routine." Furthermore, work that is useful for the company—even if it is somewhat monotonous—may feel rewarding simply *because* it is useful. Some of these supervisor concerns can be mitigated through consistent feedback: supervisors can explain how the work contributes to a bigger picture for the workplace, and students can ask questions about the potential significance of their work. In addition, as some of the informants mentioned, this is also a way for the mentors to discuss newer findings and new methods, because the students are also bringing knowledge from their universities to the companies.

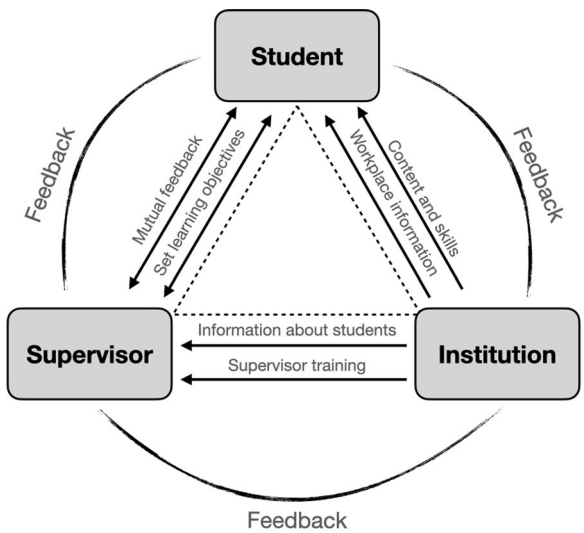

Fig. 3 Our suggestion for visualizing communication would not be complete without the inclusion of consistent, two-way feedback between all corners of the work-practice triangle

Conclusion

This study highlights the potential of internship courses to bridge academic learning in STEM fields with real-world applications. We present a comprehensive analysis based on the experience from workplace supervisors and outline the potential challenges involved and the role of mentorship to optimize the benefits of internships. The results focus on the need for clear and coordinated communication between all parties. As this communication cannot always be assured to happen organically—and, based on our findings, it often does not—we advocate for building clear communication expectations and structured feedback mechanisms into the program structure (Fig. 3). Supervisors are keen on ensuring student success. They face constraints from academic structures and worry about exploitation and ensuring rewarding experiences. With clear and consistent communication as a formal part of these programs, many of the concerns voiced by supervisors could be mitigated, thus improving the experience for all parties—the student, the host, and the institution.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40594-024-00518-y.

Additional file 1.

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Author contributions
JRS data interpretation, initial manuscript draft, and revisions. TA designed focus groups, data collection, and data interpretation. SB connected team

to focus group participants, and manuscript revisions. EFE designed focus groups, data collection, and data interpretation. KH project coordinator, led focus groups, initial manuscript draft, and revisions. IM connected team to focus group participants and manuscript revisions. JS coordinated focus groups and manuscript revisions. AS data interpretation and manuscript revisions. SZ designed focus groups, data collection, and data interpretation. GvdM connected team to focus group participants and manuscript revisions. GV project conceptualizing, designed focus groups, and manuscript revisions. SC secured funding, project conceptualization, initial manuscript draft, and revisions. AKL designed focus groups, led data interpretation, and revised manuscript. All authors read and approved the final manuscript.

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Availability of data and materials
The data sets generated and/or analysed during the current study are not publicly available due Norwegian data privacy laws but are available, in deidentified form, from the corresponding author on reasonable request.

Declarations

Competing interests
No potential conflict of interest was reported by the author(s).

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