A QUALITATIVE INVESTIGATION OF STUDENTS' DESIGN EXPERIENCES IN A WORK-INTEGRATED LEARNING SETTING

Nickel, Jordan (1);
Rennick, Chris (1);
Litster, Gregory (2);
Hulls, Carol C.W. (1);
Hurst, Ada (1)

1: University of Waterloo;
2: University of Toronto

ABSTRACT

Work-integrated learning (WIL) – a pedagogy that integrates academic studies with workplace experiences – presents an excellent opportunity for students to "deliberately practice" their design skills. To date there has been little investigation into the effect(s) of WIL experiences on developing novice designers' design skills.

We performed a series of longitudinal interview case studies following three engineering students through the course of a 4-month work term. Interviews were semi-structured to gather rich contextual descriptions of participant experiences designing in WIL settings. Transcripts were analysed using an iterative thematic analysis approach.

Results indicate specific areas where WIL helps develop novice designers' engineering design skills and mindsets beyond their early experiences in the engineering classroom. These include their experiences interacting with clients/users, the importance of project transition considerations, resource coordination, teamwork/collaboration, and the design process. We discuss how the structure of design tasks and their environment differ from the classroom experience, highlighting how WIL can supplement traditional design education.

Keywords: Work-integrated learning, Design education, Design practice, Education

Contact:
Nickel, Jordan Joshua
University of Waterloo
Canada
jnickel@uwaterloo.ca

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1 INTRODUCTION

Work-integrated learning (WIL) is an umbrella term referring to pedagogies in which work experiences are intentionally embedded in the curriculum. WIL takes many forms, and as its prevalence grows in engineering undergraduate and graduate programs (e.g., Diaz and Han (2022), Marar et al. (2022), Mazhar and Arain (2015), Reedy et al. (2020), Smith and Trent (2021), Stewart and Chen (2009)), so has researchers' interest in understanding the extent and nature of student learning in this setting and best practices for integration with classroom learning. It is assumed that WIL experiences provide rich environments for students to gain authentic experience in designing; yet, research on design learning in WIL settings is limited (Litster et al., 2021).

In this paper we report on a study that explores how engineering students experience design in a design-centred WIL context. Through a series of three longitudinal interview case studies, we collected and analysed rich qualitative data, generating insights on key features of design experiences in this WIL setting and how they differ from design in the classroom. The rest of the paper is structured as follows. In this section we provide a brief background on WIL and review the limited prior research on students' design learning while in WIL settings. We describe the research gap and research question that motivate this work. In Section 2 we outline our study methodology, including a detailed description of the WIL setting in which the study took place. Study results are presented in Section 3, with key findings and implications for design teaching and learning discussed in Section 4.

1.1 Introduction to WIL

As a pedagogical approach, WIL intentionally structures workplace experiences into the academic curriculum (International Journal of Work-Integrated Learning, n.d). WIL programs typically include a partnership between an academic institution, a host organization, and the students themselves. Although there are different models of WIL, such as the sandwich degree, internships, service-learning courses, practicums, and co-operative education, they all involve the integration of practical workplace learning and academic learning (Drysdale and McBeath, 2018). WIL experiences have been found to have a positive effect on both academic achievement and work readiness. In an early study of co-operative education at Mississippi State University, Blair et al. (2004) reported that compared to regular stream students, engineering co-op students had higher GPAs and higher starting salaries. Jamie et al. (2020) found internship experiences provided benefits for student autonomy, project management, and use of technologies during their final year capstone design projects. Students participating in WIL programs have demonstrated improved performance in all "employability" areas, including their knowledgebase, engineering ability, and professional attributes (Mandal and Edwards, 2022).

1.2 Design learning in WIL experiences

Given the academic benefits of WIL experiences for student learning in general, Litster et al. (2021) conducted a literature review to investigate what design knowledge, skills and abilities were being developed during WIL experiences. Originally curated by Liu et al. (2020), the 30 papers included in their review were empirical studies of engineering students' WIL experiences in the workplace. Litster et al. (2021) found limited evidence of what - elements, systems, or processes - students were designing in these settings, but it found evidence that students were gaining experience and confidence in one or more stages or aspects of the design process, including design project management and the iterative nature of design; establishing design requirements and constraints; comparing and judging design alternatives; modelling, building and testing; and design documentation. Importantly, the review also found that students participating in WIL experiences were developing an understanding of and recognizing the importance of designing in a larger context, taking into account the environmental, social, political and ethical situations we face (Titus and Oakes, 2011).

Investigations of students' design learning in WIL experiences can inform design pedagogy for when those students return to the classroom. Of particular relevance here are accounts of the influence WIL experiences have on the capstone design course, as discussed by Bailey (2007) and Jamie et al. (2020). More recently, these efforts have extended to investigations of how intentional academic instruction on design can be scaffolded while students are immersed in a WIL experience in industry. For example, Nespoli et al. (2018, 2021) describe a case study in which students received tutoring in a virtual design studio while immersed in design practice in an international internship.

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1.3 Study aims and significance

While the review by Litster et al. (2021) provides some good high-level evidence that WIL experiences provide a rich context for engineering design learning, their findings are based on a secondary-data analysis of articles that had a different intended purpose. Further, much of the evidence is based on students' perceptions of their self-efficacy, typically collected through surveys, sometimes months after the WIL experience had concluded. Acknowledging these limitations, at the conclusion of their review, Litster et al. (2021) call for more in-depth explorations of student design learning during WIL experiences.

Motivated by this research gap, the exploratory study described in this paper aims to gain a clearer picture of student experiences of design/designing in real world contexts and how the environmental factors therein affect their designing. The research helps to give a perspective on how to improve student design learning in classroom contexts by improving our understanding of student experiences of design in real contexts and how that differs from current classroom instruction.

2 METHOD

The present study used a series of three longitudinal interview case studies following three engineering students through the course of a 16-week co-op work term. The study received approval from the research ethics review board at the University of Waterloo.

2.1 Setting

The University of Waterloo has one of the world's largest WIL programs in the form of cooperative (co-op) education. All engineering students must complete at least five (and up to six) four-month work terms during their degree. Students apply to, interview for, and are matched with co-op placements through an internal system. Approximately half of the students have their first co-op after only four months of study, with the other half going out to their first co-op term after 8 months of study. Co-op terms are paid, fulltime employment in companies spanning the globe, in virtually every industry sector.

Each term, a small number of students are also employed by the university itself, in various units and roles. One of those on-campus employers is the Pearl Sullivan Engineering IDEAs Clinic, which has the mandate to develop hands-on, educational activities to advance undergraduate engineering design education at the University of Waterloo (Hurst et al., 2019; Rennick et al., 2022b). These activities are hands-on, real-world design activities - frequently co-developed with industrial partners - with an emphasis on curricular integration and student design self-efficacy development. To support the considerable effort that is required to design, develop and test the activities, since its inception in 2015 the IDEAs Clinic has employed more than 200 undergraduate students during one of their co-op work terms. In general, these co-op students take on the role of instructional designers - tasked with the design and implementation of new curricular activities for other undergraduate students. The co-op students act as the main designers of the activities, being involved in all aspects of activity from conceptualization to implementation in the classroom. Figure 1 below illustrates some of the equipment that the co-op students have been tasked with designing.

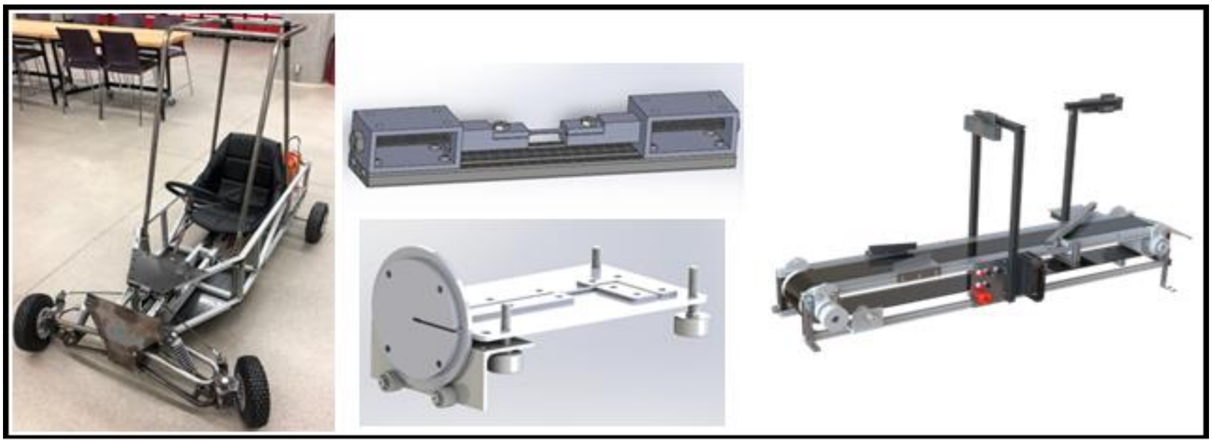

Figure 1 Sample co-op student projects (from left): 1:3 scale electric car; low-cost materials testing devices (tension, top; torsion, bottom); small scale industrial conveyor belt

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Rennick et al. (2022a) investigated the level at which students employed by the IDEAs Clinic were demonstrating the graduate attributes developed by the Canadian Engineering Accreditation Board (CEAB), with a particular emphasis on design. Their analysis found that the work associated with creating new classroom design activities provides opportunities for students to develop their engineering skills including design, collaboration, and communication, and that the environment within the IDEAs Clinic enabled students to demonstrate graduate attributes at levels beyond their academic level - an excellent environment for cognitive skill development (Ericsson, 2003).

2.2 Participant recruitment and interview protocol

Three study participants - all male-presenting - were recruited via email from a population of 12 co-op students working in the IDEAs Clinic in winter 2022. All three were working on real-world design activities for clients internal and external to the university. The participants were all in the first half of their programs (viz. mechanical engineering, nanotechnology engineering, and biomedical engineering), and none of them had yet undertaken a final year capstone design project. Any cornerstone design projects in their first year were virtual due to the COVID-19 pandemic. A series of ten weekly interviews with each student were performed in weeks 6 to 16 of the 16-week cooperative work term; each interview approximately 30 minutes in length. These interviews used an adaptation of the "echo" interview method (Bavelas, 1942), a semi-structured interview approach well suited to gathering rich contextual descriptions of participant experiences. The method prompts participants to consider how people and technical factors from their context influence and affect the situations they encountered, and the outcomes of those situations. By prompting the participants to recall specific, concrete examples of behaviours and influences from these contextual factors, the method also minimizes recall bias.

2.3 Analysis

The transcripts were analysed using an iterative thematic analysis approach (Braun and Clarke, 2006) by a graduate student who previously completed an undergraduate degree in engineering at the institution, providing them with first-hand experience of the co-op program in engineering. The dataset was iteratively coded and analysed using the Dedoose software package (Dedoose, 2021). The initial passes were primarily inductive, where interesting and salient excerpts in the transcripts were identified and common topics were synthesized from these excerpts. These topics were reviewed against each other and against the transcript data to iteratively group and adapt the topics until the list met two criteria: internal homogeneity (data within a code is coherent) and external heterogeneity (clear distinctions between codes) (Patton, 2015).

3 RESULTS

The interviews provided a large and rich dataset, which was analysed under multiple lenses. In this paper, we report on key themes that fall under the umbrella of comparing the participants' experience of design on their work term to that in their courses. In the following subsections, we describe each of the themes and include direct quotes from the participa to illustrate key points. For ease of reading, we refer to the study participants as "designers" or "student designers" to differentiate them from the students who in this case are in their study term participating in the learning activities, and thus the intended "users" of the designs.

3.1 Dealing with clients and users

The designers expressed many difficulties that they encountered as they interacted with clients and users. Compared to their experiences in the classroom, during their work term the design goals that they were provided by clients were vague and required interpretation:

> *"I haven't been communicated in terms of any budget or anything like that, just with the pretty vague goal of making it as cheap as possible, but as best quality as possible"*

Moreover, the clients did not always present the design brief to the designers all at once, further challenging them to revisit previous decisions. The designers' interpretation of design needs and goals did not always align with the users' and clients' interpretation; as the designers worked on the design they needed to reconcile this misalignment in expectations.

The designers also commented on their experiences presenting design solutions to the clients and users and the impact of this activity on their design work. Their designs underwent many design reviews

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that were critical to future design iterations. While design reviews were initially held virtually, once they began to be held in person the designers were able to better communicate with the clients about the design solutions (e.g., could point at specific parts of the physical design rather than having to describe with words):

> *"That's when I found that a lot more progresses was made[sic], because there's a much better communication between ourselves and the professor that was supervising. They were able to come in and see how the device works and see how everything happens."*

One of the designers highlighted how sometimes design reviews exposed completely new aspects of the design:

> *"One thing that sort of differed from like the classroom, I feel like in the classroom, more often, you like know most of the information upfront, so when if you do have like, sort of a meet with your professor or something or TAs, where they give you critiques, it's normally stuff that you are aware of, or like, 'Oh, that makes sense'. And less often where it's completely unknown to you, I guess."*

As they witnessed their prototypes and final design solutions in the hands of their intended users, the designers expressed their surprise in witnessing how users used their design in unexpected ways and did not utilize the provided guidance:

> *"…we provided a pretty extensive manual or instruction page on how to do a lot of steps that they'll need in the project or just useful information that'll help them in their projects and I found that a lot of students just didn't even read it, or they skipped over it, …whether it was, like, consciously or not."*

3.2 Project transition

Perhaps one of the biggest identified differences from designs on study terms was the impact and role of project transitions. Development of these activities frequently requires more than a single work term to complete. Designers could use pre-existing designs as inspiration, and sometimes were tasked with working on pre-existing designs, which gave them the opportunity to focus on improving small aspects of the design rather than beginning new designs from scratch. The designers identified many challenges and issues in their design that directly related to either transitioning the designs from previous designers or the need to facilitate handover of their designs to future designers.

When working on an ongoing project, designers used transition documents to learn of work completed by their predecessors. Given the high turnaround of student designers (each co-op term only lasts 16 weeks), frequent transitions between designers inevitably led to loss of information or data relevant to the design, potentially causing safety risks:

> *"A lot of the PLCs that we had got fried, because people didn't know that plugging it in through both the Ethernet and DC would kill it. So I think we lost like three of them. So without the documentation on the PLC, I wouldn't have known that. So, it was risky."*

The designers described the challenges of having to produce missing documents for a project after it had been handed off to them. To avoid "hunting for old files", they sometimes perceived that it would be easier to just restart a project from scratch. More often though, they had to build upon or alter previously completed designs. As such they sometimes needed to manage inherited design errors and failures, discovering problems that were not documented when attempting to proceed with the design:

> *"I had a meeting with my supervisors, and we discussed redesigns to the torsion testing machine that are basically going to change the whole machine. So I thought it was pretty much like finished, and I just have to digitalize the output of the torque that we read and the angle... But now we've noticed another problem that wasn't addressed earlier, like not even earlier this term, but also when it was first designed last term from another student."*

Some of the issues could be traced to the interpretability of transition documents. Having well-organized documentation allowed the designer to trace the decisions and rationale used previously, so that they could apply it on their own project. Well-organized and crosslinked transition documents helped the designer get up to speed quicker and understand the design direction. However, due to the many and continuously changing stakeholders, the workplace lacked a cohesive organization scheme for transition and design documents, making it difficult to locate and interpret the designs. This was especially challenging for designers unfamiliar with the technical background required to understand them:

> *"It was too technical, because I wasn't sure what... I haven't been taught how to read circuit diagrams yet, or what they mean. So even with an explanation as I learned some of it but there's still more confusion there that didn't, I didn't need to have all the knowledge for later on."*

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The designers also described the difficulties they encountered from the poor quality and lack of standardization in transition and design documents. They commented that some of the documentation they had encountered was haphazard and not done to best practice (e.g., used poor naming conventions), was out of date to the most recent prototype or design iteration, or contained superfluous information. Even when transition documents were available, pressured by project deadlines, some of the designers admitted to not reading or referencing transition materials, thus working on a design direction without understanding the rationale that drove previous decisions and sometimes leading to setbacks:

> *"But rather than jumping into like the documentation, everything that they had provided us from last year, I just kind of focus on other projects, which was still getting work done, it just probably wasn't helpful for [this] project, because by not reading the documentation earlier, it probably set me behind as to where I could have been."*

As the designers encountered challenges when taking over existing projects they also reflected on lessons learned for transitioning their work to future designers. They commented on the need to document their reasoning for the design decisions they had made so that future designers could follow the logic of their design, ensuring that documentation was up-to-date and thus representative of the current state of the design, and standardizing and collecting all transition and design documents so that they were not in disparate locations/file folders.

3.3 Resource coordination

The student designers were exposed to many aspects of resource coordination, including budget, human, material and time resources, that they might have otherwise had limited exposure to in their courses. Designers had to generally think about budgetary considerations, which were typically provided as a guidance rather than hard constraints:

> *"Looking at the fuel cells, it has come into play, but we're significantly below budget. So if we spend an extra $300 on a fuel cell, it's fine. So, it hasn't really come into play. But it is something that I'm keeping an eye on if something is an outrageous price, we tend to avoid it."*

The designers generally described their difficulties in estimating and managing time, both theirs and that of others in their teams or other stakeholders. Additionally, the designers worked within the bounds of many deadlines, both internal and external, and needed to learn about and distinguish between negotiable and non-negotiable ones. Firm deadlines were often those that were driven by factors completely outside the scope of the actual design project, such as government funding for a project. Uncovering necessary "last minute" changes prior to a firm deadline caused significant stress and uncertainty.

> *"That was actually another challenge that we ran into in terms of the deadline…adding the last-minute touches was very hard… So timeline wise, we were definitely very pressured."*

While larger high-level deadlines on projects were set by their supervisors, the designers were responsible for scheduling many of the tasks and saw first-hand the difficulties in correctly estimating timeline requirements for tasks. Schedule delays were sometimes caused by failures and risks that were not adequately predicted and accounted for:

> *"But obviously, with delays and setbacks with the BME project, it was harder to stick to that timeline for the torsion testing device, just because there was a few points where a couple of weeks straight [] most of my time was spent doing calibration. So I lost out on quite a bit of time there."*

Another source of delays was procurement of hardware components. The designers described how they were not always aware of appropriate sources to obtain required components and generally found the procurement timeline and process to be obscure and not in the designer's control:

> *"I guess one issue or, like, trouble we kept running into is where to like source parts from, because neither of us had really ever done a lot of parts sourcing, especially for something like a bike. So that was something that was challenging."*

While they could use scrap and spare materials that did not perfectly meet requirements to build and test prototypes, they needed to source materials from reputable vendors for the larger quantities of components required in their completed designs, which had to scale to be used by entire classes of students.

The project timeline posed significant constraints on their design process, especially when having to split their focus between two or more projects or tasks (with different timelines and priorities) simultaneously or having to rely on support from outside the design team, which introduced additional unpredictability.

The designers also learned that many deadlines were negotiable and frequently changing over the course of several terms, impacted by several other projects' deadlines, and adjusted as the design iterated and unpredicted changes occurred. Ultimately, many design decisions needed to be made based on how different alternatives aligned with the project timeline, and sometimes logistical delays necessitated changes to the design. The designers described continually negotiating schedule with supervisors based on their project progression.

> *"Every day [my supervisor and I] have daily meetings, and I explain what I was doing the previous day, and how things are progressing towards that. And then we can shift certain aspects from there."*

3.4 Teamwork and collaboration

During the work term, the student designers had to interact and collaborate with a variety of other stakeholders in the design project, from other student designers to their supervisors, other university staff, clients, suppliers, and intended users of their designs. They described performing regular check-ins with stakeholders to receive feedback that guided both the design progress and their learning:

> *"Yeah, the helpful things are certainly just making sure we're on the same page, and showing them the updates because I can talk about... For instance, in the daily meetings, I can talk about, Oh, I did X, Y, and Z. But some professors or other supervisors that aren't always in those daily meetings, they go a week without seeing or hearing about what I've done. So the weekly meetings definitely allow us to all get on the same page."*

The student designers described many of the challenges they encountered in communicating with other stakeholders. Some difficulties were directly related to many of the meetings being held remotely; the designers expressed that communicating in person was more effective for building a common understanding of the design project, whereas in remote meetings they sometimes struggled to follow what aspect of the design others were referring to. They also commented on how in-person meetings were more effective for navigating through contentious decisions, especially for those that were more conflict-avoidant:

> *"Communicating in person is so much better than communicating online, because it's so much easier to understand people. And even resolve conflicts, sometimes you'll have a conflict online, that you'll just sort of keep to yourself, or you have a preference of how you want to something to go. But you won't normally say it, because you don't want to cause tension in an online setting. Whereas talking things through in person, or even asking questions is a lot easier. Because you are able to clarify much more easily."*

Other communication challenges were due to different degrees of understanding of the design as well as differences in technical knowledge:

> *"I guess this is one of the big challenges ... understanding what both of my supervisors have in mind. And then me updating it from the previous design to this. And making sure that we're all sort of on the same page..."*

In another example, one of the student designers described how they were not able to articulate why the design was structured the way it was to manufacturing technicians and therefore could not receive actionable advice from them.

3.5 Structure of design process

In the interviews, the student designers were also prompted to describe what they perceived to be the differences in the design processes followed during the work term compared to what they had experienced in their courses.

One of the main differences that they identified was how iterative the design process was on their work term compared to their classes. They described how in the classroom, design projects are much more focused on the deliverables to be graded - the solution is either "right" or "wrong". The design project is left at a "good enough" stage and students' supporting evidence for functionality, verification and validation is held at a lower standard. The design process as a whole was perceived as more linear, constrained to prevent tangents and schedule overruns:

> *"Yeah, I guess like, sort of major difference I've been like noticing is, sort of when you're given a project in the class, for instance, you're normally given all your sort of constraining factors right away, just because they want you to not waste as much time going like off on tangents and stuff like that, and really just focusing on stuff they like deliverables they want so they can mark from."*

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This no doubt was exacerbated by the remote learning environment during the Covid-19 pandemic (see Rennick et al. (2021) for a discussion of this in a first year course).

Design projects in the classroom are thus structured to avoid iteration, instead forcing a sequential progression that is tied to the schedule of content taught in the course:

> *"Yeah, so the classroom design, it's more so the professor laid it out for us where... okay, in this week, she teach us how to do this, and then we go and we apply it to the design. The next week, we learned how to do this when you go to apply to the design. Whereas this you're just learning everything and doing it when you have time or as it comes up."*

Instead, on their work term, the designers experienced iterative design, as a reaction to its natural progress rather than as part of planned iterative process:

> *"This one is a lot more iterative…And it is certainly a lot more challenging, because you do have to, you find a problem, and you solve it."*

Another big difference between design in the classroom versus the work term was the nature of the design problems to be solved. The designers described the problems they were working on in their work term as open-ended, with vague goals and requiring them to identify constraints themselves rather than being provided with an exhaustive list. This allowed for multiple different solution approaches, and as such, the designers had the flexibility to determine their own design "path" and to iterate as necessary, a process of "learning as you go" and discovering through design:

> *"…it feels more like the real world versus when you learn in a class, you're learning and then applying it whereas these things, I may have already learned them or it may be learning them as I go because I ran into a problem that I didn't even like realize."*

4 DISCUSSION

4.1 Implications for engineering design pedagogy

At many Canadian institutions, design is taught and assessed primarily in first and fourth year. There is a large gap (in terms of time and complexity) between the highly structured process of a first-year cornerstone course and the open-ended nature of a final year capstone. In first-year projects, while it is possible to include elements of multi-disciplinarity, project management, and real-world stakeholders, processes like procurement, budgeting, and shifting timelines are frequently either removed or highly controlled by instructors, removing many of the complexities students will face in real-world design situations. Clearly, it is not possible to expose students to all the complexities of real-world engineering design all at once in one project; even capstone projects have some scaffolding, e.g., intermediate project deliverables. These experiences need to be distributed throughout the curriculum, slowly adding in additional elements to increase complexity as the students gain stronger foundations in engineering.

This raises many questions, of course: Is it effective to teach these complexities in pieces, or do they need to be experienced together? How many times do students need to experience the risk of procurement or manufacturing, or changing stakeholder requirements, before they have internalised those lessons? There are other considerations to think of as well; the supports in these projects need to be carefully designed to either keep students away from frustration, in the zone of proximal development (Vygotsky, 1978), or to quickly help them recover.

Lastly, design courses emphasize that iteration is central to design, and yet the student designers in this study did not perceive much, if any, iteration taking place in their design projects in the classroom. When a design fails in the academic setting, there is frequently no time to re-design. Students will instead make the smallest change they can to get a working prototype for the deadline, effectively *refining* and troubleshooting - both common in real-world design settings, but fundamentally different from *iterating*.

4.2 Implications for employers of novice designers

As co-op students join an organization for a short window of time, transparency, structure, and support are critical. The student designers often did not understand why certain projects were prioritized over others, and why those priorities shifted. In these situations, transparency on changing priorities could help make clear to students why deadlines are fluid and could reduce some of the frustration they feel. Our study participants were mostly working in-person, however their supervisors and other collaborators were frequently working remotely. This hybrid environment is challenging for both the designers and the supervisors as it can impact communication, and lengthen the time to resolve issues.

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Recent research on virtual WIL experiences have highlighted the advantages and disadvantages of remote WIL practices for students and their employers (Maietta and Gardner, 2022). For global enterprises with distributed design teams, more care is required, especially with new graduates.

Finally, in academic settings, students typically only ever produce early prototypes of a design; and these prototypes rarely need to persist beyond their time in that course (service-learning projects, or capstone projects which lead to entrepreneurial enterprises might be exceptions to this rule). There is a vast difference between generating the first prototype and producing a polished product with complete documentation that can be sold by a company. WIL employers should expect to spend considerable time and effort assisting students with polishing their design work, verifying the quality of their work and helping them with documentation, locating/evaluating information (e.g., parts suppliers, internal capabilities), organizational or sector-wide standards, and complying with regulations.

4.3 Limitations and future work

The small number of participants in this study limits the generalizability of the findings. First, the work terms described here cannot be representative of the nearly 20,000 co-op placements from University of Waterloo students, set in virtually every industrial sector around the globe. Not all work terms will expose students equally to these additional complexities of design in the real world. Anecdotally, many work terms, especially early in students' careers, provide few, if any, design opportunities. Second, the types of tasks present in this work environment tend to skew towards mechanical, electrical, and software engineering, and so students from other disciplines like civil engineering are not well represented here and may face different problems when transitioning from academic to professional work environments.

There is much that we can do to better prepare students for the realities of real-world engineering design, but the problem of what do we teach students, and when, is a complex one. Are first year students, with virtually no disciplinary training, ready for the complexities of real engineering problems? If not, how much training do they need first? WIL continues to not receive much research attention in regards to design learning, even though it shows great promise as an environment to learn the skills required to be successful in real-world design environments. At the same time, WIL should not be relied upon as the only setting where students receive authentic design experience. These environments are highly variable, and the match between student and workplace can impact what they learn in that setting. Future studies will better characterize the strengths and limitations of design learning in these settings.

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