Reducing the UX Skill Gap Through Experiential Learning: Description and Initial Assessment of Collaborative Learning of Usability Experiences Program

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Abstract. There exists discrepancy between the skills possessed by Human Computer Interaction (HCI) students and the expectations of user experience (UX) industry. This skill gap lowers HCI students' successful transition from academia to the field of UX. To reduce the skill gap, HCI educators have started to integrate experiential learning techniques into their teaching, ranging from workshops to service learning and industrial internships. In joining their efforts, we have created an innovative usability training known as Collaborative Learning of Usability Experiences (CLUE) for HCI students of all levels. In this paper, we detail CLUE's unique experiential training components—UX Internship, Short Courses, Workshops, and Knowledge Transfer—and we report the assessment of the program by evaluating our graduates' job placement and their academic achievement and also by examining our UX industry partners' evaluation of the program and student interns on five important UX skills.

Keywords: UX Education, Experiential Learning, Usability Training.

1 Introduction

User experience (UX) professions are popular career paths for Human Computer Interaction (HCI) students [1–3]. This career trajectory makes sense as a wealth of skills and knowledge acquired by HCI students are fundamental to design, research, and develop user-centered products that are championed by service industries and governments [4]. To best prepare students for the workplace, HCI educators are putting immense effort to include experiential learning components in their courses and curriculum. Such effort is essential to bridge the gap between the actual skills possessed by HCI graduates and the expected skills in these graduates by hiring managers and employers (i.e., skill gap) [5, 6]. Hiring managers and employers have questioned the effectiveness of traditional teaching methods in preparing HCI students for the UX labour market [7] and this concern over skill gap has motivated them to rely on students' experiential learning involvement to judge their work-readiness [8].

In this paper, we describe our own innovative training program to enhance HCI students' employability. The Collaborative Learning of Usability Experiences (CLUE)

has four unique components, specifically UX Internship, Short Courses, Workshops, and Knowledge Transfer. In this training program, we attempt to decrease skill gap by giving HCI students the opportunity to work with leading UX experts and to expand their knowledge and skills on technical and professional skills, ranging from cutting-edge UX research and design tools, teamwork, communication, ethics, and programming. CLUE stands apart from the traditional "chalk and talk" method of teaching by incorporating various experiential learning techniques.

In what follows, we first provide relevant work on skill gap, experiential learning, and innovative HCI education. Then, we detail CLUE's four training components, outlining each component's learning objectives and activities. Next, we report the assessment of the program success in four different ways: (1) student job placement (2) industry and government partners' evaluation of student interns on core UX skills, (3) the quality of relationship with industry and government partners, and (4) student academic performance. The first two metrics can serve as evidence of successful skill gap reduction. If students have a competent range of employability skills expected by employers, they will receive job offers and positive skill evaluation from industrial partners. The last two metrics tell us whether the program has done well to maintain positive relationship with internship partners, which is crucial to sustain the program, and whether the program has influenced students' academic performance.

Our contribution lies at advancing the current state of HCI education by creating one cohesive experiential training program that enhances HCI students' UX skills and knowledge. We share the details of the program, so that it can become a point of reference to be implemented and modified for other HCI educators. We highlight the creative elements and structured training components of CLUE that have made the program successful over the past six years.

2 Related Work

We provide relevant work on skill gap, experiential learning, and innovative HCI education. Given the interdisciplinary nature HCI, in this paper, we define HCI students as those whose research focus center on understanding the interaction between human users and computer from diverse perspectives, including psychology, human factors, computer science, industrial design, information systems, and more.

2.1 Skill Gap in HCI Students

UX professions are red-hot professions of the 21st century [4]. The Nielson Norman Group has estimated their growth factor to be 100% from 2017 to 2050 [9] and CNN Business has estimated the growth factor of 19% for UX researcher and of 13% for UX designer for next 10 years [10]. Against this high demand for UX professions, HCI students are ideal candidates to meet this demand given their extensive training on user-centered research, design, and development [3]. However, hiring managers and employers have noted the lack of core UX technical and professional skills in new HCI graduates. Radermacher and Walia [5] found that recruiters viewed written communication, oral communication, project management, and teamwork as most

deficient knowledge in new computer science graduates. Gonzales and colleagues [6] conducted content analysis of UX job postings and compared required skills listed by recruiters and employers against actual academic training received by human factors graduate students. The result revealed that there was an overlap between the required skills and the received training (e.g., knowledge elicitation, tasks analysis), but there were also skills that were not being taught to students (e.g., visual design, basic programming).

The presence of skill gap can be attributed to many factors: faculty's limited understanding of which UX skills are needed in industry [11], faculty's emphasis on training teaching technical knowledge (e.g., prototyping and software development, research and evaluation methods) as opposed to professional skills [12], and a program's heavy reliance on traditional learning approaches. In these approaches, students passively absorb knowledge with limited interaction with teachers and peers and they do not apply their classroom knowledge to solve simulated and/or real usability problems [13].

Skill gap is concerning for all stakeholders—the student, the employer, and the university. From the student's perspective, they will have a hard time securing UX professions after graduation. Even after securing a position, they may fail to adjust in the professional working environment since they originally lack core UX skills. Given that employers expect new graduates to work effectively upon being hired with limited supervision [14], new HCI students may not have enough support to develop essential skills. From the employer's perspective, skill gap means new HCI graduates will significantly deter the organization's productivity, including slowing down the production of new products [15] and lowering the company sales performance [16]. From the university's perspective, skill gap means they have failed to educate the next body of UX professions, with the long-term consequence of hurting the economic development of the country [17]. Against this, experiential learning can help close skill gap and we will now discuss the core features of experiential learning.

2.2 Experiential Learning and Innovative HCI Curriculum

Experiential learning occurs when students learn by doing or learn from experiences [18]. In this learning, students are exposed to *concrete* experiences and they *reflect* on these experiences by noting the differences and similarities with their prior experiences. Then, students engage in *abstract conceptualization* where they make connections between old and new experiences and form a new set of theories and generalizations. Finally, students engage in *active experimentation* where they apply their theories to solve new problems. Recent years, HCI educators have increasingly incorporated experiential learning given its superiority in cultivating work-readiness skills in students than traditional classroom activities, including practical knowledge, understanding of the corporate culture, ability to take initiative and adapt to change, team work and project management skill [19], ability to cope with stress [20], being an empathetic [21] and creative thinker [22], and ability to manage unexpected events [23].

Experiential learning in HCI education comes in many different flavours, with each empowering students to be an active participant. Leshed [1] reported their Advanced

HCI class at Cornell that combined traditional lectures with student-led workshops. Musabirov and colleagues [24] introduced two courses—User Centered Design and Information Systems Architecture—where students role-play as a designer or developer on usability projects to closely reflect the real working environment of UX. Murad and Munteanu [2] described a user experience design course in which students worked on client-facing projects to learn about agile software development. Lazar [25] described Web Design Course where Information Systems students designed websites for local communities. Among these different forms, industrial internship and service learning are viewed most effective to enhance students' employability [26, 27], as they immerse students completely in the professional working environment.

We now detail our own training program which has incorporated experiential learning techniques to prepare HCI graduate students for the UX labour market. Our program is similar to other HCI training programs; it exposes students to concrete experiences (e.g., workshops, internships) that initiate the cycle of reflection, concrete abstraction, and active experimentation. Yet our program is unique; it offers students with well-rounded exposure to different forms of experiential learning (vs. one), thereby strengthening each other's positive effect on students' development of work-readiness skills. Other usability training programs tend to focus on giving students with real UX projects and they do not offer structured training over a long period of time [28, 29].

3 Collaborative Learning of Usability Experiences (CLUE) Training Program

3.1 Program Overview

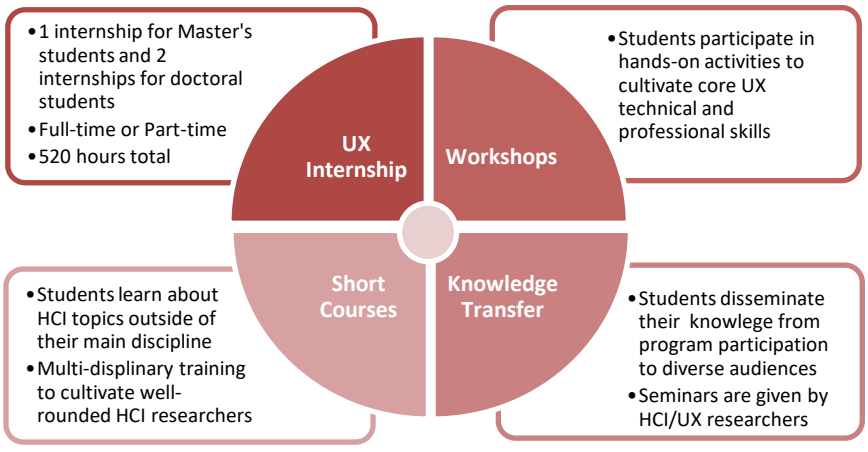

Fig. 1. Four Major Training Components of CLUE

Collaborative Learning of Usability Experiences (CLUE) is a usability training program primarily dedicated to HCI graduate students. It also supports the growth of undergraduate and postdoctoral students by giving them the opportunities to conduct usability research with the program faculty. CLUE is led by Carleton University and supported by Queen's University and Ontario Tech University. It is funded by the National Sciences and Engineering Research Council of Canada (NSERC)'s CREATE program, which supports an innovative educational training program designed to prepare graduate students for careers in industry, government, and academia. There are four training components: UX Internship, Short Courses, Workshops, and Knowledge Transfer (Fig. 1). Each training component has been designed to teach students with technical and professions skills that meet the demands of UX industry.

Students learn about basic UX knowledge, methods, and concepts through Short Courses, Workshops, and Knowledge Transfer before they participate in internships. This order of program progression is crucial. Experiential learning theory, which is a widely adopted pedagogical framework in curriculum design, suggests learners need to face concrete knowledge before they can progress to other major learning stages [30].

Through UX Internship, students work with leading UX experts from industry and government. They apply theories, methods, and technologies from classes to address real usability problems. There are two structural factors that make internship accessible to graduate students. First, unlike co-op and other internship programs, CLUE offers students internship opportunities with its partners and thus it relieves them of the pressure of finding a host organization on their own. Students are easily discouraged from applying to internships because they do not know how find suitable host organizations [6, 31]. CLUE removes such accessibility barrier by partnering up with industry and government partners and make internship opportunities as accessible to many students as possible. Second, CLUE provides research assistantship to students while they complete internship and it removes students' concern for financial loss during internships and partners' financial burden.

Workshops and Short Courses prepare students for their internship. Workshops teach students professional and technical skills. Short Courses expose students to HCI topics that are outside of their major. For instance, graduate students of psychology can participate in a short course on programming while students of computer science can participate in a short course on design methods and prototype development. Lastly, Knowledge Transfer allows students to network and learn about effective communication in two ways: seminars and student-led presentations. Seminars bring together students, HCI communities, and the general public in one shared space. Students are financially supported to attend and present their research projects at local and top-tier international conferences. They also present their internship experiences to their peers. Table 1 lists the critical elements in CLUE.

3.2 Main Stakeholders

There are three main stakeholders in the program—students, industry and government partners, and faculty—and this section provides information about each stakeholder.

Program and Student Relationship. Graduate students who show strong interests in UX and academic and personal competencies can join the program with the support of their thesis advisors. Once joined, the program provides New Student Orientation to new students that outlines all the key elements of the program. For past six years, CLUE has trained over 96 students of diverse degree program and Table 2 provides the background of past and current CLUE students of all levels.

Table 1. Critical Elements in CLUE

Name of Element	Brief Description
New Student Orientation	New CLUE students learn about their responsibilities and available opportunities, including internship requirements, seminar/workshop/short courses attendance, and conference funding.
UX Internship	The student participates in a full-time or part-time internship with the program's industry and government collaborators.
Mid-placement Interview	The program coordinator meets the student and the mentor at the mid-point of their internship (2 months after the start for full-time internships and 4 months after the start for part-time internships).
End-of-Internship Report	The student completes a written end of internship report that provides an overview of their learning experiences, accomplishments, and suggestions to improve the program.
End-of-Internship Presentation	The student gives presentation about lessons learned during internship.
Seminar, Workshop, & Short Course	The student must attend 10 seminars and 3 workshops/short courses. Seminars last an hour while workshops and short courses last 2 to 3 hours. They occur about 2 to 4 times per month.
Symposium	This annual event invites all stakeholders of the program, specifically the faculty, students, and mentors, to learn about each other's profession, expertise, and research projects. The community is also invited.
Student Handbook	This handbook details general program requirements and informs the student to keep learning journal and tips on receiving feedback. It also has a checklist that the student can use to check off their major milestones in meeting the program requirements.
Industry Partner Handbook	This handbook provides an overview of placement procedure and tip on coaching and mentoring the student.
End-of-Internship Feedback Survey	Industry and government partners evaluate student interns and the program after 2 weeks of internship completion.
Internship Agreement	A document that details the host organization's mentor and legal responsibilities and it needs to be signed before internship.
Website & Social Media	The program has a website that lists all events happening in each month and other important program information and its own YouTube channel housing past seminars and a LinkedIn group page that connects all CLUE students, partners, and faculty.

Table 2. CLUE Student Information

Level of Studies	***n***	**Program of Studies**	***n***	**Program of Studies**	***n***
Bachelor's	17	Cognitive Science	7	Interactive Multimedia and Design & Industrial Design	7
Master's	51	Computer Science	13	Psychology	7
Doctoral	19	HCI	28	Serious Games	1
Postdoctoral	3	Information Technology	22	Design	5

Program and Partner Relationship. Initially, the program had already established partnerships with 33 industry and government partners. We have continuously fostered new partner connection is several ways: new partners came across the work of CLUE students and faculty at academic and professional conferences (e.g., CHI) and expressed interests in joining the program, graduated students introduced CLUE to their new workplace, and existing industry partners had moved to a different new organization and then initiated the relationship with their new organization.

There are three requirements to become the partner: (1) they had to be a UX expert on site to provide mentorship to the intern, (2) a physical working space allocated as their desk, on-site as part of a team environment (prior to the global pandemic), and (3) the ability to assist students in the contribution of their skills to work on projects relevant to the growth of the company. To further validate their eligibility, potential partners send their CVs and job opportunities for CLUE students to the program director.

Our industry and government partners have come from diverse sectors. Industry partners belonged to Design, Computer Software, Real Estate, Computer Games, Information Technology and Services, and Aviation and Aerospace industry; Government partners have belonged to departments in charge of researching aerospace, public safety, general government services, and immigration and citizenship. These partners are employed by organizations of varying sizes, ranging from startups (11-50 employees) to multinational corporations (over 350 thousand employees worldwide).

Program and Faculty Relationship. CLUE has recruited faculty across disciplines to design cross-disciplinary training program and the core faculty is composed Engineering & Design, Computer Science, Business, Arts, and Social sciences. Their representative areas of expertise are computer vision, tangible user interface, serious games, cognition, usable security, agile software development, and architectural denotation.

3.3 Training Component: UX Internship

Internship Preparation. Industry and government partners send job descriptions to the program director at the start of each internship cycle (Fall, Winter, Summer). These

descriptions outline the responsibility and required qualifications and skills for a given position and they are posted on the CLUE website. Students decide on the timing of internship with their thesis supervisor and consider factors such as expected graduation and candidacy and course requirements. Through the validation of internship positions by the program direction and the discussion of appropriate internship placement with thesis advisors, students can ensure to meet their internship and academic learning goals. Students prepare an application package: a cover letter, resume, and portfolio. The program coordinator sends the packages to the corresponding partners. Next, industry and government partners contact potential candidates and conduct interviews. Then, students and partners rank each other and matched based on their preferences. After a successful match, students receive an internship placement letter that outlines all important deadlines, including the start and the end date, mid-placement interview, the end-of-internship presentation and report.

Internship Placement. Students are assigned with a mentor and a UX team. CLUE students take on diverse UX-related job positions, ranging from UX architect, Design Researcher, Human Factors Researcher, User Interface Designer, UX Programmer, and Business Intelligence Analyst. Table 3 provides examples of what our students have done in their internships. As some partners have limited experience with supervising graduate students, we take active approach to ensure good mentorship is provided. Our mid-placement interview reflects one approach. This interview ensures students and mentors are satisfied with their internship experience. The coordinator meets with each mentor and student independently to hear about any concerns and then all parties discuss as a group to resolve concerns. Our enforcement of the mid-placement interview and the program requirement that host organizations must provide a mentor ensures students will have meaningful learning experience. Over the past six years, we have offered 81 internships with 42 partners from 28 organizations.

Table 3. Illustrative Examples of CLUE Student Internship

Students	**Position**	**Internship Responsibility**
Student A	UX Designer	The student assisted launching a company's new online service: they created simple pen-and-pencil sketches and low- and high-fidelity prototypes of website using Balsamiq and Figma and defined user journey.
Student B	UX Software Developer	The student assisted in developing tools for UI/UX artists that allow them to convert their Sketch scenes into UI for a game without needing to write any line of code.
Student C	UX Specialist	The student redesigned the government's internal websites. They initiated ideation session using Trello Board, took charge of usability testing—recruiting participants, running testing, and analyzing data—and presented findings to UX team.

Internship Termination. When internship is over, students share their internship experience with other CLUE students. In this 20-minute presentation, students talk about what they have learned, be it technical or professional. In past, students have presented on topics including how to have an effective communication with software developers and how to navigate the communication ladder in the government. Students also submit the end-of-internship report 2 weeks after internship is over. This report outlines 5 components: (a) the kinds of work undertaken during internships, (b) relationship between work experiences to the student's academic studies, (c) the student's challenges and accomplishments, and (d) the strengths and weakness of the work experience, (e) suggestions to improve the experience, and (f) the contributions of the student to the work.

Training Component: Workshops, Short Courses, and Knowledge Transfer. Students are required to attend 10 seminars and 3 workshops/short courses. Table 4 summarizes the targeted technical and professional skills cultivated during workshops, short courses, and seminars. Also, students are financially supported to present their research projects at local and international conferences and they are supported to attend UX professional conferences, including CanUX and UXR Conference.

Table 4. Targeted Skills for Workshops, Short Courses, and Knowledge Transfer

Targeted Technical & Professional Skills	Description	Examples of Presented Topics
Ethics	Students learn about being an ethical HCI researcher.	Ethical challenges for HCI field, Ethical Conduct of Research Online Modules.
Accessibility	Students learn about accessible design and research and websites and applications for legislation on accessibility.	Inclusive research for people with disabilities, eAccesbility and accessible assistive technologies.
Entrepreneurship	Students learn about the process of starting a business and commercialization.	Thinking like an entrepreneurial researcher, the Business of game development.
Intellectual Property	Students learn about, IP management, patents/trademarks, copyright, and licensing.	Logistics involved in applying and owning patents.
Research Thinking	Students see cutting-edge HCI research by HCI researchers/UX practitioners.	Mobile device app development, designing deformable sensors, using crowdsourcing platform.
Interpersonal Skills	Students learn interpersonal skills for workplace.	UX project management of UX project, preparation for UX interview, cross-culture teamwork, and digital storytelling for children.

4 Initial Assessment of CLUE

We examined past students' job placement and industry and government partners' evaluation of student interns. These metrics give us some evidence of whether the program has decreased the UX skill gap: past students' job placement after their graduation indicates students were successful in securing UX professions, supposedly due to their possession of core UX skills from participating in the program; industry and government partners' evaluation of student interns informs us whether internship has cultivated core UX skills, namely independence, self-reflectional capacity, teamwork, professionalism, and dependability [3]. We also examined students' academic achievements to see their overall growth as HCI researchers and our industry and government partners' program evaluation to get a glimpse on how the program should improve.

4.1 Student Job Placement and Academic Achievement

Our data show CLUE students have successfully secured UX professions (Table 5). We have had 90 students in the program: 47 have graduated from universities and 41 have not graduated yet. Focusing on the graduates, 39 out of 47 students have transitioned to UX roles and a half of their employers had connection to CLUE (Table 6); we do not have information on the remaining 8 students who have graduated. For those who went to pursue careers in universities, they became research associate and assistant/analyst.

Table 5. CLUE Graduates' Job Placement

Position Title	***n***	**Position Title**	***n***
UX Researcher/ Design Researcher	16	Storytelling Developer	1
Unknown	8	Data Science Software Developer	1
UX Designer/ Interaction Designer	6	Human Factors Researcher	1
UX Specialist	2	UX Manager	1
Software Developer/Developer	3	Product Manager	1
Research Associate/Assistant/Analyst	4	IT Analyst and Developer	1
Engineering Specialist	1	UX Instructor	1

Table 6. Employer Type and Employer CLUE Affiliation

Employer Type	***n***	**Employer CLUE Affiliation**	***n***
Industry	19	Yes	17
Government	16	No	22
University	3		
Self-employed	1		

CLUE students also show strong publication records (Table 6). As of spring 2021, we have witnessed 116 papers and posters published in journals and conferences and 30 awards and scholarships that recognized the student's outstanding academic achievement. Students presented and published at top-ranked HCI conferences (e.g., CHI, DIS, TEI). Majority students were first author and published their research projects on usability in collaboration with thesis supervisors, industry partners, and lab. The social connection that was formed at internship has presented a few of them with additional opportunity to work on research projects with industry partners.

Table 7. Publication and Academic Achievement of CLUE Students

Type of Publication and Awards	***n***	**Examples of Venues**
Conference Presentations, Posters, & Demonstrations	105	Int. Symposium on Aviation Psychology, CHI Conference on Human Factors in Computing Systems, DIS Conference Designing Interactive Systems, Spatial User Interface Conference, International Symposium on Wearable Computers, Int. Conference on Cloud and Big Data Computing, Int. Conference on Information, Intelligence, Systems and Applications, CHI PLAY, TEI Int. Conference on tangible and Embedded Interaction
Journal Articles	11	Computers in Human Behaviour, IEEE Internet Computing, IEEE Pervasive, Games for Health Journal, Int. Journal of Child-Computer Interaction, Int. Journal of Cyber Behaviour and Psychology Learning.
CLUE and local university presentations	68	End-of-Internship Presentation, Symposium, Graduate Colloquium, University Learning Forum, CAPCHI
Technical Reports and Non-refereed Articles	21	Research and Development Technical reports, Interactions Magazine
Awards and Scholarships	30	Provincial Scholarship, International Excellent Program, Provost Scholar Award, University A Senate Medal for Outstanding Academic Achievement for Master's work, Scholarship of Teaching and Learning, Best Paper Honourable Mention Award at DIS, Best Demonstration at ACM Spatial User Interface Conference, Postgraduate Scholarships

4.2 Industry and Government Partner Evaluation

We analyzed 22 industry and government partners' responses in the End-of-Internship Feedback survey using qualitative and quantitative approach and Table 8 presents the questions that were analyzed for this paper.

Table 8. Questions for Industry Partner

Questions Asked	Question Label
Q1. Would you recommend the student for future employment?	**Employment Recommendation**
Q2. Will you participate in CLUE again?	**Partner Future Participation**
Q3. The intern demonstrated an awareness of their strengths and weaknesses (1 = strongly disagree to 5 = strongly agree)	**Self-reflectional Capacity**
Q4. The intern demonstrated the ability to be an independent worker (1 = strongly disagree to 5 = strongly agree)	**Independence**
Q5. The intern worked effectively with others on team projects	**Teamwork**
Q6. The intern exhibited a professional attitude and behaviour (1 = strongly disagree to 5 = strongly agree)	**Professionalism**
Q7. The intern exhibited a sense of responsibility and dependability (1 = strongly disagree to 5 = strongly agree)	**Dependability**
Q8. Can you recommend actions that CLUE could initiate to better support you in your coach/mentor role?	**Mentor Support**
Q9. What additional support could CLUE provide to better maximize the usefulness of the program?	**General Support**
Q10. What additional preparation could interning student have had, prior to starting work, which would have increased the usefulness of the internship?	**Student Preparation**

Analysis of Quantitative and Binary Questions. For **Employment Recommendation**, we see that 24 students will be recommended for future employment, 4 students have received job offers from their internship organizations, 2 students were not given a clear answer, and 2 students received the response 'Maybe.' For **Partner Future Participation**, 20 of our partners expressed strong interest in participating in program again and only 2 partners said 'No.' Lastly, the partners positively evaluated the students on their independence, self-reflectional capacity, teamwork, professionalism, and dependability, with means for each skill nearing 5 (Fig. 2).

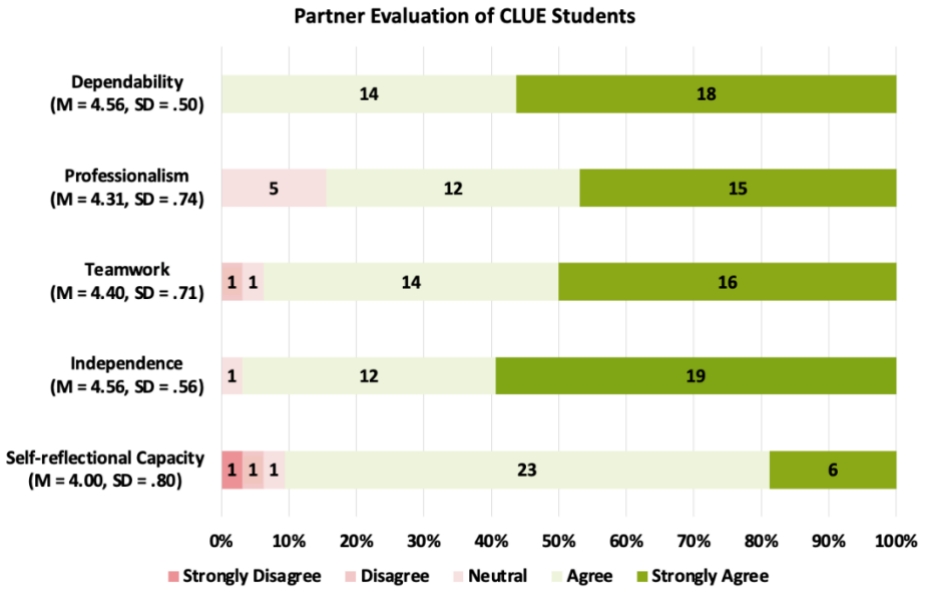

Fig. 2. Partner Evaluation of CLUE Students on Core UX Skills

Analysis of Qualitative Questions. We conducted thematic analysis on the last three questions. For **Mentor Support**, we found three themes—**Information**, **Pre-Internship Preparation**, and **None**. Under **Information**, industry and government partners expressed they wanted better guidance on mentoring and clear learning outcomes for students during an internship: "*Clear guidelines on skills that CLUE interns should gain from* their *experience*" and "*It would be good to have the opportunity to hear about what other organizations are doing with the interns to learn from one another."* They also wanted important information to be placed at one place, "*Single trusted source with dates, and assessment/evaluation materials/links"* Under **Pre-Internship Preparation**, partners wanted a student to be prepared, skill-wise and mindset-wise: "*Foster a willingness to try, to fail, and to learn, a desire to push herself to try new things even with the risk of being wrong/bad and taking the feedback*" and "*It would be useful to have a list of 'transferable skills' that the interns are expected to be familiar with before they join.*" Under **None**, partners were satisfied with current support and two partners especially appreciated the mid-placement interview: "*I think the current systems of midterm check in and end of term review works well*" and "*It's good that you have a check in period to ensure it's a mutually good fit for both mentor and student.*"

For **General Support**, we found three themes: **Information, Other,** and **None**. Under **Information**, partners wanted to learn about how to evaluate a student, how other partners coached their students, and how students evaluated their internship experiences: "*Would be useful to see final deliverables from past CLUE internships in order to gauge how much students typically accomplish during their term*" and "*Invite students to provide feedback on their experience working with us*." Under **Other**,

partners expressed they wanted the internship process to start earlier, to have more students involved from the two supporting universities, and prepare students to work in profession settings. Under **None**, partners were satisfied current support and liked CLUE's mid-placement interview.

For **Student Preparation**, we found 3 themes: **Better Knowledge, Clear Learning Goal, and None**. Under **Better Knowledge**, partners wanted students to develop better understanding of a company before starting internships by using their product, reading case studies on the website, and more: "*Perhaps read up on our products and tried them out*" and "*Not required, but a better understanding of the type work the company is doing – supply chain or electronics - would help with the learning curve of what company does, vs the product they are working on in UX design*." They also wanted students to develop technical (e.g., Sketch, Illustrator) and soft skills (e.g., project management, business culture): "*If anything perhaps some experience with online UX research and design tools would be useful*" and "*more education and activation on project management … stakeholder engagement, project management, communication soft skills always a nice baseline to build off.*" Under **Clear Learning Goal**, partners wanted students to have clear learning goals during internship: "*Worksheet for students to capture their internship learning goals*" and "*Having a more structured internship would be helpful for the students, as they would know what is expected of them."*

5 Discussion

CLUE is an innovative usability training program for HCI graduate students, with providing additional support to undergraduate and graduate students. In this paper, we reported the critical elements and initial assessment of the program. CLUE is not the first usability training that has been created to enhance the employability of HCI students for the UX labour market: there are other likeminded HCI scholars and educators who have offered usability training in varying forms, ranging from student-led workshops to service learning [1, 24, 25]. However, it is the creative elements of CLUE (see Table 1) and the sheer scope of training that has been purposefully targeted to cultivate core UX skills that make the program most deserving of HCI educators and scholars' attention. In below section, we define the success of CLUE at three different levels and discuss recommendations and future work.

5.1 Defining the Success of CLUE

The success of CLUE can be assessed by asking three questions. First, we can ask, "Has the program decreased the UX skill gap by equipping students with core UX skills?" and we have some confidence to say the answer is 'Yes' based on our metrics. There are several program elements that are noteworthy. Prior to starting their internship, students actively participate in seminars, workshops, and short courses to develop baseline UX-specific professional and technical skills. While completing their internships, we can infer elements such as learning journal and mid-placement interview encouraged students to reflect on their weakness and strengths and learning

goals, further fueling their motivation to refine their skills and do well on assigned UX projects. All these program elements operate together to push for the growth of students as UX professions and the evidence of decreased UX skill gap is most evident in our partners' positive evaluation of student interns on give important UX skills (see Fig. 2) and their willingness to recommend student interns for future employment. We believe our partners provided fair student assessment because they took on one student per term and they contextualized their assessment to the individual student.

In addition, we observed that almost half of our graduates secured a position at organizations affiliated with CLUE. Our anecdotal evidence indicates that students received job offers from the organizations that they interned at or they received job offers from the organizations with whom they only had met during the CLUE placement interview. This direct recruitment from the program is remarkable for two reasons: it shows CLUE students became attractive junior UX professionals who met partners' expectations and it shows CLUE's standing as a trustworthy program that trains students with employability UX skills.

Altogether, we believe reduction in the UX skill gap depends on both teaching methods and educational contents. CLUE's training components forces students to become active learners. For instance, in Workshops, students participate in group discussions and hands-on activities rather than passively receiving information. Students also learn about up-to-date UX knowledge on a monthly basis.

Second, we can ask "Has the program maintained positive relationship with industry and government partners?" and the answer is also 'Yes.' Our results indicate the mid-placement interview was an important element that contributed to partners' satisfaction with the program; this element was repeatedly mentioned in partners' responses to two open-ended questions (**Mentor Support** and **General Support**). Students are perceived as the key stakeholder in internships and thus HCI educators and scholars' efforts have been dedicated to making sure their experiences stay positive [32, 33]. However, it is our view that equal efforts should be placed to ensure satisfying partners' needs. In general, host organizations have two major needs when they host student interns: (1) students who are qualified and motivated to assist full-time employees and (2) students who can teach them new things and excite them with fresh ideas [29, 34]. Failure to satisfy partners' needs will inevitably lead to partner dissatisfaction, which in turn will influence their interaction with students and their willingness to continue the partnership with a program. Our mid-placement interview was a perfect venue to check mentors' needs fulfillment with students and the program and act accordingly.

There are other creative elements in CLUE that serves to enhance positive partner-program relationship: the program's financial support to students while they complete internship and the opportunities to form industry-industry and industry-faculty connections by attending seminars, workshops, and symposiums. Looking at the program as a whole, we have had 42 partners from 28 organizations since the beginning of the program and 17 organizations have repeatedly recruited CLUE students. For instance, one organization has hosted students for three years while another organization has hosted students for five years. This number adds to another line of evidence attesting to the success of CLUE in maintaining positive relationship with our partners.

Lastly, we want to highlight the possible positive spillover effect of internships to students' academic performance. We saw strong publication and scholarship records by CLUE students. One can assume the program's constant exposure of cutting-edge HCI research in seminars and workshops and numerous conferences have contributed to their academic achievement. This observation aligns with prior studies demonstrating the positive effect of internships on students' academic performance, including enhanced GPA [35] and greater likelihood of completing university [36]. While the primary objective of CLUE is enhancing students' UX employability skills, this finding suggests the program can prepare students to pursue careers in academia.

In sum, we have defined the program success at three levels—decreased UX skill gap, maintenance of positive partner-program relationship, and improved academic performance—and demonstrated how various program's creative elements and scope of training make the program stand apart from other usability training.

5.2 Recommendations: Developing a Successful Usability Training Program

We make several recommendations to HCI scholars and educators on how they can create an effective usability training program. Our recommendations are based on CLUE's weaknesses that have been identified in the initial assessment and our reflections over the past six years in managing the program. We first outline a set of recommendations a program can consider for students.

1. **Refining New Student Orientation.** A program should explicitly tell students about why they should strive to produce good work at internship. Students have drastically different expectations and understanding about internships [27, 37] and it is possible that students do not make automatic connection between good internship performance and future job offer from host organizations. Helping students to make this explicit connection can motivate them to attend and participate in Seminars, Workshops, and Short Courses diligently, so that they feel ready for internships.
2. C**ollaborating on Seminars, Workshops, and Short Courses Topics.** CLUE has successfully offered seminars, workshops, and short courses on skills that were mentioned by our partners (e.g., project management, communication). At the same time, partners have also mentioned a few tool-specific skills (e.g., Sketch, Illustrator) that students can benefit from learning prior to starting internship. First, a program can compile a list of these tools which students can familiarize themselves with tools through online and University resources. Second, we propose partners and a program to collaboratively create training topics and teach students with curated professional and technical skills that accurately reflect the current UX practices and technologies. This collaboration is especially useful if a program and its participating faculty have limited exposure to UX industry.
3. **Supporting Student Interaction**. CLUE offers training to students from three universities and there is a higher number of participating students from the leading University A. Prior to COVID-19, while students saw each other in-person at Symposiums and UX conferences, their interaction was typically limited with CLUE students who were also from their university. Even after COVID-19, establishing

meaningful interaction between students from different universities has remained equally difficult, with reduced non-verbal cues and physical presence and warmth that characterize online meetings. A program can create a student-only online space (e.g., Slack) where all students can converse with each other about any topics.

We now outline a set of recommendations a program can consider for their industry and government partners:

1. **Providing Industry Partner Orientation**. Our industry and government partners repeatedly expressed the need for an improved coaching guide. This implies some of them did not find the current Industry Partner Handbook as enough resource to learn about being a good mentor. Instead of presenting partners with a text-based Industry Handbook, a program can consider providing an orientation at each internship cycle and invite industry and government mentors to have an open discussion on (a) what it means to be a mentor, (b) what are useful mentoring strategies, (c) how to set learning goals, and (d) how to evaluate student progress.
2. **Creating Information Package About Organization**. Some partners expressed students can develop better knowledge about their organization prior to starting internship. In addition to the job descriptions, host organizations can share the program with information package that outlines (a) the mission of the organization, (b) organization structure. (c) organization rules, policies, and expectations, (d) intern's responsibilities, and (e) links to their case studies and prior projects [38].
3. **Facilitating End-of-Placement Feedback Session for partners**. Our industry and government partners seldom received in-depth suggestions on how they can improve their role as the mentor and as the host organization. Questions such as, "did the student value the project that they worked on?" and "were my mentoring strategies effective to achieve their learning goals?" remain unanswered and unimproved for next incoming student interns. We suggest a program can consider the end-of-placement meeting or mediating a focus group where students share honest experiences with program partners.

5.3 Limitations and Future Directions

There are several limitations with our initial assessment of CLUE and these limitations open up exciting future directions. First, we examined the effect of the program on decreasing the UX skill gap by surveying students' job placement and partner's evaluation of students on five UX skills. Prior research has achieved the same objective by asking employers to evaluate their recently hired graduates on important skills [39, 40] in which they compared newly hired graduates against full-time employees. In contrary, our partners may have evaluated students' UX skills by comparing the student from their start and the end of internship (i.e., within-individual comparison) and this comparison may not necessarily inform us on how comparable students are against full-time UX employees. Furthermore, students' job placement can be attributed to factors unrelated to CLUE. Future researchers can adopt more standardized ways to assess the effect of a program on decreasing the UX skill gap by including comparison data. For

instance, they can compare students who participated in a program versus those who did not participate in a program on employment rate or types of landing jobs.

Relatedly, our students' academic achievement can also be attributed to factors unrelated to CLUE. Future researchers can obtain comparison data that show changes in GPA throughout students' tenure in a program as stronger evidence.

Second, our assessment does not inform us how students found program's critical elements. We understand industry and government partners' appreciation of a specific program element (i.e., the mid-placement interview) and their desire for a new program element (e.g., a better coaching guide) through administering a survey with open-ended question. But the same assessment approach has not been adapted for students. Future researchers can consider conducting surveys or focus group with students to identify program elements that have facilitated their experiential learning journey.

Third, we did not report CLUE faculty's experience of the program. Prior research indicates that faculty who are involved in the internship program experience unique difficulties, including their time commitment and service not being recognized in tenure review [41] and their lack of clear guidance on how they should be serving the role as an internship program faculty [42]. At this point, we only have anecdotal stories to illustrate CLUE faculty's experiences with the program and we recommend future educators to incorporate more formal assessment approach to evaluate faculty's experience with their usability training program. Lastly, HCI educators and researchers should be cautious in generalizing our results to UX training programs that are in a different format than our program

6 Conclusion

CLUE offers students a comprehensive learning experience and incorporated experiential learning technical in every training component. Our work has identified the details of the program, from initiating relationship with industry partners, type of evaluations to ensure the program success, type of targeted professional and technical skills provided. Thus, we invite other HCI educators and practitioners to use our training program as a point of reference as they design a curriculum to prepare graduate students for UX careers. In future, we plan to engage in more comprehensive assessment of the program by evaluating the experiences of all three stakeholders—students, industry partners, and faculty—and this assessment will add to our current understanding of the effectiveness of CLUE in bridging the UX skill gap.

Acknowledgement

This work was supported and funded by the National Sciences and Engineering Research Council of Canada (NSERC) through the Collaborative Learning in Usability Experiences CREATE grant (2015-465639).

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