A collaborative autoethnographic analysis of industry-academia collaboration for software engineering education development

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Abstract –*As engineering educators seek to prepare students for future careers, it can be challenging to keep course materials current with industry practices and knowledge. Students also often experience a disconnect between their studies and perceived relevance to future industry roles. This study examines the potential impact of an industry-academia collaboration on the development and improvement of software engineering education while addressing these issues. A collaborative autoethnographic approach is used to concurrently analyze the experiences of both industry and academic participants in the collaboration. Common themes across the collected personal reflections show that varied benefits were experienced by all stakeholders while contributing to an improved student experience.*

Keywords: industry-academia, collaboration, course, design, software engineering, autoethnography

1. Course and Collaboration Background

As demand for software engineering programs continues to grow, there is a critical need for industry and academia to collaborate, whether in research or in the training of future engineers [2, 3]. Industry-academia collaborations help to support innovation, improvement, and relevance within software engineering topics [10]. While these two communities are often disconnected, industry practitioners contribute to a better understanding of technical project elements and necessary real-world industry skills [1].

During the height of COVID-19 and online teaching, Instructor M and Instructor B were both newly assigned to teach "ENSF 409: Principles of Software Development". Both felt that the course was due for a refresh to align better with industry practices and expectations of future software engineers. ENSF 409 is a mandatory course for second year software engineering and third year computer engineering minor students, but an optional technical elective for fourth year electrical engineering students. This results in a wide variety of skill sets and experience among nearly 300 students. The course objective is to provide a study of software design and development topics, with a focus on object-oriented programming and design.

The teaching team consists of two instructors (Instructor M and Instructor B). Both instructors are proponents of research-informed and industry-informed pedagogical practices. They have spent time in industry and have first-hand experience of the differences in expectations that sometimes exist between coursework and employment. One of the motivations for forming the collaboration with industry professionals was their desire to prepare students for the sort of problems they will actually face in their work. The instructors also believe that if students understand the relevance of the course material and how it relates to their chosen career, they will be more enthusiastic about the class. While it can be challenging to incorporate elements beyond the technical syllabus, it is important for students to see the industrial relevance of software development aspects such as requirements, testing, and process improvement [9].

Rather than teaching two sections as separate offerings, the instructors decided to integrate their sections as a single experience for all students. To provide equivalent and cohesive instructional content, the instructors implemented a flipped classroom paradigm with recorded videos and synchronous weekly lab sessions coordinated

by both instructors and a collective TA team. A single D2L site is used to coordinate both sections as one large cohort. All communications are sent on behalf of both instructors, and students are asked to cc both instructors on all emails. This approach was expanded in Winter 2022 to incorporate hybrid lab sessions with simultaneous in-person and online support. This hybrid approach will continue to support students facing challenges with the transition to in-person learning, regardless of physical or mental health, travel, or accessibility concerns.

When developing the technical content, the instructors decided to seek industry input on current tools, practices, and processes to better prepare students for their future internships and careers. Literature suggests that involving industry experts in curriculum design and delivery enables the development of industry-relevant skills and innovative teaching strategies that better reflect real-world engineering practices [4]. Initially, the purpose of the industry consultation group was to review content to identify any disconnect between the proposed instruction and industry expectations for new employees. Particular emphasis was placed on identifying knowledge that students frequently lack upon graduation. This desire to integrate industry perspectives led to the formation of a regular consultation group. Over the course of a year, the instructors met weekly with a group of industry experts for approximately two hours to discuss course content and delivery related to software engineering courses. While the initial purpose of this collaboration was to integrate industry perspectives and up-to-date knowledge in the ENSF 409 course, the group's goals expanded further over time, as will be explained in this paper. This study uses a collaborative autoethnographic approach to analyze and examine the impact of the group on both the academics and the industry participants. Each team member has provided their own observations from being part of the collective, as well as a description of the impact on their own work or personal experiences.

2. METHODOLOGY

The primary methodology used in this paper is the qualitative research method of collaborative autoethnography. Autoethnographies build connectivity between the self and others by combining context and data about oneself [5]. This type of analysis provides a valuable opportunity for educators to reflect on their own experiences and observations of pedagogical interventions. A collaborative autoethnography further develops this methodology by allowing multiple authors to self-reflect and integrate their own qualitative experiences and perspectives alongside their peers [7]. Collaborative autoethnographies also facilitate each researcher engaging in the work as both an active participant and as an observer [6]. Autoethnographies allow researchers to explore issues through a personal

context while evaluating their own actions and experiences [8]. An autoethnographic approach was used to collect and analyze the experience of each participant in the academic-industry collective. This methodology is best suited to analyzing the experiences of the academic-industry group as each member alternated their own role as teacher, student, or observer depending on the weekly topic.

There are varied models of collaboration within collaborative autoethnographies, from a sequential passing of the narrative to a concurrent sharing and analysis of stories [5]. This paper uses a concurrent approach where each researcher collected their own data, then participated in the determination of common themes across the various perspectives. Each researcher was asked to reflect on their own involvement and identify any significant outcomes as a result of their participation. These experiences are grouped according to emergent themes and provide a synthesized perspective on the potential benefits of industry-academia collaborations and the positive impact on engineering education.

The tasks and roles undertaken by each member varied throughout the discussions. While the primary focus of the group began with developing and enhancing higher education courses, the group adapted to fit the individual needs and circumstances of members. Weekly topics varied, depending on what active problems were being faced. In addition to academic support, the group worked on preparing two members for job interviews, helping industry members develop pedagogical material for use in tutoring and teaching, and other technical challenges. This variation of support and roles helped to encourage buy-in and commitment from all stakeholders, which is recommended as a best practice for industry-academia collaborations [2, 10].

The collaboration tasks related to ENSF 409 included the revision and development of slides and teaching material, suggestions of course structure and topics, debugging of technical challenges, networking, mentorship and feedback opportunities, and the development of an autograding assessment tool. Including industry perspectives was central to course design, and other professionals were also engaged for smaller components such as guest speaker videos and a panel discussion. Group participants also volunteered to provide project feedback to student groups in ENSF 409, watching video demonstrations and providing suggestions for improvement or future development.

Upon the conclusion of ENSF 409, the group decided to continue with the weekly meetings. As a team, they continued to bring new topics and content for discussion. For example, Instructor M sought advice on the best installation and process practices for an industry-focused graduate course. Expert GJ later began a sessional teaching position and benefitted from discussing pedagogical and classroom management techniques.

Instructor B sought input on a new graduate course for software development using open source. During her industry career and in her research, Instructor B has been engaged in free/libre/open source software (FLOSS), and was therefore interested in developing a course which considered both the academic perspective on FLOSS, as well as the development of skills originally associated with FLOSS but now widespread in industry.

The industry group brainstormed with Instructor B to identify the topics which should be covered in the course, and to develop the course outline. Members of the group also reviewed the slides, and ultimately contributed several guest lectures via video recording, on the topics of cross-platform software development (Expert GJ), designing for accessibility (Expert AJ), reproducible builds (Expert RS), containerization (Expert GJ), and documentation (Expert LL). Two members of the group also participated in online labs. Expert RS and the other creator of Covid Virtual Tools, a private messaging application used in a Vancouver hospital, offered a Q&A opportunity on their FLOSS project. Toward the end of the course, Expert GJ viewed the students' project work and provided them with feedback on their code.

Following the course conclusion, the group returned to focusing on the next cycle of ENSF 409, considering revisions to the lecture material and improvements to the automatic assessment tool.

3.   RESULTS

Throughout their own reflections on their involvement in the group, patterns began to emerge between the feedback of the academics and the industry members. Each member provided a personal reflection, which was then broken down and coded to match similar themes across the various reflections.

Results from the academic perspective include the creation of modernized and relevant course materials, real-world problem sets, and industry feedback on final design projects. Students were exposed to expertise beyond what a single instructor can provide, including perspectives on documentation, devops, accessibility, and more. Instructor M and Instructor B were pleased that the collaboration became an opportunity for code review and technical assistance. Another benefit was the ability to help students see the relevance of course material to future careers through guest videos and panels. Following the industry guest panel, several students reached out to the professionals individually for further mentorship and also joined the suggested online groups for networking and workshops. The instructors also reported that students were positive about their interactions with industry guests, saying that the experiences helped them see the relevance of the class topics to industry, to be motivated toward their goals, and to consider the variety of careers available to them. One student with industry experience told

instructors that they believed the course structure prepared students for industry.

As a result of these consultations, Instructor M and Instructor B chose to incorporate working examples of code in the slides and videos. The code used in the course is provided to students in a public git repository, with weekly releases timed to coincide with the video and slide release. This allows students to open the code and follow along with the video, or to pause the video to examine in more depth.

Industry members felt that preparing and participating as a guest lecturer was intrinsically rewarding as an exercise in communicating knowledge, and further validated the opportunities provided by participation in the collaboration. One industry member stated that involvement in this collaboration and the subsequent opportunities to interact with students led him to pursue sessional teaching work at a local institution.

3.1.   Collaborative Autoethnographic Themes

Common themes that emerged from the personal reflections included the sharing of pedagogical practices, impact on student preparedness, addressing and filling technical gaps in knowledge, and the advancement of communication and mentorship skills. One thread that runs across the various themes is the enjoyment that people took from the collaboration activity. Some of the words used to describe the group were supportive, non-competitive, collaborative, enriching, intersectional, positive, inclusive, and inspirational. Expert LL described himself as honored to have been a part of the project, while several participants found it reflective of the best aspects of collaborative software development and research.

3.1.1.   **Sharing of Pedagogical Practices.**

A common interest in the quality of education was one of the factors which led to group cohesion. The theme *Sharing of Pedagogical Practices* describes how knowledge around the effective education of students was transferred from those with experience in teaching in higher education (Instructors B and M, Expert AJ) to experts whose previous experience was primarily focused around mentoring. Discussions about educational practices were a contributing factor in making the collaboration mutually beneficial.

Expert RS: Instructors B and M have offered a wealth of experience in pedagogical and practical sharing of knowledge, which has created a professional study hall atmosphere that I look forward to attending weekly. This empowers us to bring high quality educational experience to our local community through nonprofit organizations like TAGNW. This, in turn, may feed forward into more higher education engagement and ultimately better industry performance. We could all be so lucky to gain

colleagues whose experience includes collaborative, self-motivated involvement in intersectional cohorts like these (or indirectly benefiting from one).

Expert GJ: The opportunity to interact with students, educators, and industry peers in this setting has been the motivation for taking the steps to legitimately join the ranks of my beloved mentors and professors. Working with Instructors B and M has helped me to understand the cycle of student and teacher interactions in a way that has greatly improved my ability to generate positive outcomes for my students and to see past what I found as obstacles originally.

Expert GD: Personally, I enjoyed learning a lot from this group of people myself. It was insightful to see how professors work behind the scenes and how they think. That was a side I never got to really see during my education, so this gave me an inside view on part of the work of professors and the effort it takes to create a course especially in the era of COVID-19 where classes were often online. It also confirmed to me that experienced professionals and academics can work effectively together.

Instructor M: Integrating modern professional practices into my course design has brought a new richness to both the delivery and the student experience. It is a pleasure to close the loop of advice by sharing the students' reactions and sharing my own knowledge of engineering education with those interested in teaching roles.

3.1.2. **Student Preparedness.**

Members of the group were motivated to prepare students for their eventual careers, which was captured in the theme *Student Preparedness*. Both instructors view exposing students to the processes and practices they can expect to encounter in the workforce as a key element of their teaching philosophies. Meanwhile, for experts, there was the opportunity to reflect on their own journey and to foster the skills that they - and by extension others in the industry - would like to see in new colleagues.

Expert RS: Seeing the team structure that these educators and engineers bring to their courses brings together the best parts of documented collaboration that pair programmers experience in industry. As educators step into their footprints there is a lot that can be learned for course material that is sustainable, continually improving and adapting to the industry students will be graduating into.

Expert GD: Being in the midst of intelligent professors and experienced professionals set the bar high for me as to how I could contribute to this endeavor. After a few discussions with Instructor B I realized that I had a perspective that was perhaps missing, my experiences as a student in my bachelor's were fresh in my mind, through

my internships I had exposure in seeing how things work in the industry, and also teaching people technical concepts through my public speaking experiences and volunteering. This allowed me to still remember the point of view of the student, which is an important element when creating a curriculum, to place yourself in the shoes of your target demographic. Sometimes being too deep into academia or the industry makes some people forget how it is like to be a beginner, or to subconsciously explain things in complicated ways.

Joining this initiative, I was able to provide input on the curriculum from my perspective, I even attended an online Q&A session where our group was asked to pop-in and answer questions if we could. I realized that I had a lot more to offer than I thought, the students seemed pleased with my answers, and I think this format is amazing because it gives students real world skills and exposure to extremely smart people that they might otherwise not have had access to easily.

Instructor B: During my years in industry, I worked with several junior colleagues who were recent graduates. While people who were actively engaged in extracurricular activities such as coding clubs, hackathons, and FLOSS projects generally had a good idea about how to approach the work, people who had only completed course work often found it difficult to adjust to industry expectations. Some of this knowledge can only be gained through experience, but I believe that if we try to make classroom experiences as close to industry as possible, students will be better prepared for their future careers.

Although the IT industry as a whole can be a good place for an autodidact, many people will benefit from a more formal education which covers foundational elements of software development. I see my role as one of providing that foundation, while at the same time exposing students to the most realistic scenarios we can design within the structure of a single course.

3.1.3. **Filling Technical Gaps.**

For many participants, being part of this collaboration was an opportunity to enhance technical skills in a cooperative environment rather than pursuing such learning independently. The theme *Filling Technical Gaps* captures this benefit. The format provided both motivation to acquire skills, as well as knowledgeable group members who could serve to guide the others. The opportunity to learn made the collaboration intrinsically rewarding for both instructors and experts.

Expert RS: As a non-credentialed participant I find that collaborating with other professionals and educators in this setting validates and deepens knowledge gained by experience. It also fills computer science fundamentals

gaps that exist as a result of this autodidactic melange. I bring the same divergent curiosity / convergent practicality that has allowed me success in the field, and have found participating in this intersectional group is well worth the time.

Expert AJ: The network provides a mountain of expertise from which I can listen and learn new skills in real-time via presentation and Q & A discussion. As a mathematician, I have very specific tasks that I want to accomplish with code – at this time, primarily for pedagogical purposes, but in some cases out of personal research interests. I prefer to work independently as much as possible, and I have used online forums in the past. However, the live discussion, step by step approach, and ultimately, the positive and inclusive environment is far more conducive, and I can contrast textbook theory with what is possible in practice, which I can pass along to students.

Expert DE: As a recent graduate from the University of La Verne in Software Development, I was eager to continue to volunteer my knowledge and share my experience. Providing feedback during the development of curriculum, slides and talks of professionals strengthened my understanding of my past coursework. These sessions also provided jumping off points that fed my autodidactic side, keeping my knowledge up to date and relevant. Given the experience of working alongside this group of individuals from across the industry has provided me with the next steps in the preparation for breaking into the software development industry.

Instructor B: Although I have extensive work experience in the software industry, it is a fast-moving field that requires lifelong learning. It can be easy to fall behind with new developments when you are no longer developing software as a full-time job. This is a concern both for my research - which I want to be relevant and useful to industry - as well as for my teaching, which needs to prepare students with current techniques and technologies. This collaboration not only helped with the course content, it gave me the opportunity to refresh my skills and to learn some technologies that weren't part of my previous work experience. Pair programming with experienced people let me bypass some of the usual pitfalls of self-directed learning. I have always found collaboration with competent and motivated people inspires me.

3.1.4. **Advancing Communication and Mentorship.**

The theme *Advancing Communication and Mentorship* relates to the development of skills associated with knowledge dissemination, and the creation and refinement of material to support mentoring. Some experts found that the regular structure of the collaboration gave them the opportunity to improve their teaching materials through peer feedback. Classroom participation also allowed them to practice communicating to a new audience.

Expert RS: Preparing for and participating as a guest lecturer [for Instructor B's graduate course] was intrinsically rewarding as an exercise in communicating knowledge, and further validated that this format lends itself to proving ground opportunities.

Expert LL: Collaborating with Instructors B and M has reminded me of the value of perspective and the benefits of collaboration. My background gave me subject matter expertise that helped me create the documentation lecture for [Instructor B's graduate] course. While workshopping the lecture, input from other participants provided valuable insights that improved the overall work. Ultimately, this benefits the students who can take this information and apply it to their future collaborations. I can't think of a better way to demonstrate the value of collaboration.

The lecture succeeded, in great part, because of the feedback and discussions that occurred throughout this project. I've adapted the lecture created here into a series of larger tutorials that I'm sharing with new writers on my team. And the content continues to grow with additional collaboration.

Expert GJ: The ability to share experiences with peers cannot be overstated as a valuable tool in becoming a better mentor and instructor. The peer mentorship model we have used also allows for a free form, supportive, non-competitive, and very enriching experience where each participant has been able to continuously take away useful tools and techniques for use in education as well as in the industry

4. CONCLUSION AND FUTURE WORK

Over the course of a year, a group of two academics and several industry experts met weekly to discuss course content and delivery related to software engineering courses. The purpose of this collaboration was to integrate industry perspectives and up-to-date knowledge in the curriculum while preparing students for future industry positions. This study uses a collaborative autoethnographic approach to examining the collective observations and experiences of the team members.

The collaboration tasks included the revision and development of slides and teaching material, suggestions of course structure and topics, debugging of technical challenges, guest-speaking opportunities, and the development of an autograding tool. Including industry perspectives was central to the course design, and other professionals were also engaged for smaller components such as guest speaker videos and a panel discussion.

In this study, each team member provided their own observations from being part of the collective, as well as a

description of the impact on their own work or personal experiences. This paper provided a synthesized perspective on the potential benefits of industry-academia collaborations and the positive impact on engineering education. Benefits were found along the themes of sharing pedagogical practices, student preparedness, filling technical gaps, and advancing communication and mentorship.

Several industry members found that they learned more about education as a result of the collaboration. This inspired them in their own teaching and learning endeavours. Expert GJ was motivated to begin teaching as an adjunct, which had long been an ambition, while Expert RS felt that he learned techniques he can apply in his local community. Instructor M felt that her teaching practice had been enriched through participation in the group.

Both instructors and experts felt that the collaboration helped ensure that the course content was relevant, realistic, and prepared students for industry careers. Expert GD described the format as giving students real world skills. Overall, students who took ENSF 409 in 2021 also expressed that the integration of industry professionals in their course experience helped inspire them within software engineering as a field.

The collaboration also provided members with opportunities to improve their technical knowledge. Sessions often became an opportunity for people to pose questions about problems they were facing, or to demonstrate something in their area of expertise. Knowledge about documentation, accessibility, containerization and other topics was disseminated. Expert AJ and Instructor B both found the experience far more conducive to learning than independent study.

Informal skills were also developed. In particular, several members felt that they had improved their communication skills, and developed content which they could continue to use outside of the context of the group.

For many, the experience was also a pleasurable opportunity to work together with other knowledgeable and motivated people. In reflections, the value of the collaboration was frequently highlighted as being motivating, inspiring, and incorporating best practices from the software industry.

Overall, this long-term industry-academia collaboration has resulted in benefits for all members. These impacts have led to improved engineering education development and integration opportunities. These benefits extended beyond the initial goal of updating course ENSF 409, into Instructor M's and Instructor B's respective graduate courses, and to supporting the individual goals of various participants.

Future plans include the subsequent revision of the same courses alongside the introduction of new material and courses, as well as longitudinal observations of the collective group. Instructor B has plans to further develop the graduate course and ENSF 409 related software tools.

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