

Scaling Experiential Learning: Using Micro-Role-Based Structures To Model Education After The Workplace (IUSE)

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Abstract

Rapid technological change has increased the need for experiential, community-engaged learning that prepares students for the modern workforce [10]. While educational technologies have helped scale content-based learning, scaling experiential learning remains challenging due to its resource-intensive nature and the complexity of mentoring authentic work. We report on a series of research projects that use micro-role-based structures to scale apprenticeship-like dynamics, model education after the workplace, and enable learners to contribute to large projects.

First, we used micro-roles to develop undergraduate research pathways to engage large groups of students in learning web development as early as their first year. We decomposed the complex process of full-stack development into a series of three micro-roles, with each serving as a quarter-long unit in a learning pathway where students can develop mastery over a growing scope of work. Student interviews reveal how they learn “on-the-job” in a micro-role context and how they transitioned from disorientation and dependence on worked examples to forming mental maps that support independent problem-solving and “learning through differences”. The micro-role structures facilitated peer and near-peer learning amongst cohorts.

Second, we used micro-roles to structure a university course with over a hundred students as a collaborative organization for community consultancy. Students were organized into various micro-roles to conduct and analyze stakeholder interviews and prototype solutions simultaneously. Conceptualizing assignments as micro-roles enabled a given week to cover a larger scope of work, and student interviews report that experiencing a large project ‘end-to-end’ helped contextualize their role and the purpose of their work. Layered mentorship structures balanced the need for personalized support and the limited time of the staff.

We conclude by proposing that micro-role-based structures offer a powerful framework for scaling experiential learning. Our two studies show different ways micro-roles can be implemented in practice to reframe learning after the workplace to enable more opportunities for real-world projects and peer and near-peer mentorship. We discuss implications and future directions for micro-role-based work.

Situated learning pathways for learning web development in a research program

Our initial exploration of micro-roles centered on creating *situated learning pathways* that provide learners with a predictable role-based path to grow from simple entry-level tasks to mastery of a complex skill like modern web development. By a role-based path, we mean a sequence of roles that one can progress through, with each clearly situated within and contributing to a larger project. All parts of the process in completing the project are represented by some role, just like in a real organization.

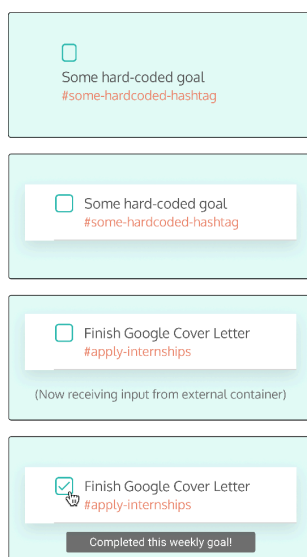
One can create these learning pathways by starting from a large complex project, thinking about what is necessary to accomplish it, and iteratively decomposing the project into a hierarchy of micro-roles. The pathway roughly (though not always) corresponds to moving up the hierarchy

in the same way a worker might move up an organization as they master their currently assigned scope of work and receive new responsibilities.

After first introducing the idea in a simple proof-of-concept that focused on developing static webpages with HTML and SCSS [1], we wanted to explore the feasibility of the idea in a much more real-world context of modern full-stack web development in a university-based program [2]. Since these learning pathways require participation over a longer period of time and the ability to have students working at different points in the pathway, it was not suitable to implement them in a traditional classroom environment. Instead, we implemented them in a skill-building program within a research lab designed to expand access to undergraduate research experiences, especially for first- and second-year students.

Micro-roles and visualizations of each of its subgoals

Components Example



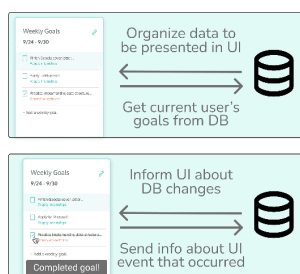
Elements
Define and style elements

Layout
Position elements on a layout

Data
Bind the UI to a data model

Events
Detect and handle events

Containers Example



Queries
Write queries to the database

Actions
Take actions to update a database

More complex as you go up vertically

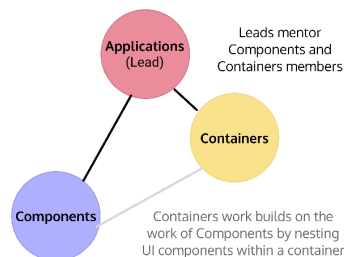


Figure 1. The three micro-roles, plus subgoals for Components and Containers. The Applications tasks were only done occasionally since setting up and architecting an application only happened once per project.

In our program, we defined an application stack and decomposed the development process into three micro-roles, each with 2-4 subgoals (**Figure 1**). *Components* is an accessible, entry-level role focused on building responsive layouts for isolated, reusable UI components while learning HTML, CSS, Typescript, and Angular. Upon mastering *Components*, learners advance to the mid-level *Containers* role, where they manage data flow between the backend database and the frontend application state through building smart components (referred to as “containers”) while learning advanced TypeScript, Angular, NgRx (frontend state management), and Firebase (backend database). In the highest role, *Applications*, experienced learners define the project’s architecture while mentoring lower-role members as leads. Each micro-role is accompanied by supporting guides and worked examples that support mentorship.

In the current program structure, learners master one micro-role per 10-week quarter, starting in *Components*, under the guidance of leads. Weekly work is organized around subgoals to create distinct milestones. For *Components*, one week focuses on the static implementation of a

component (Elements, Layout), with a second week focused on dynamic functionality (Data, Events). For *Containers*, one week focuses on retrieving data (Queries), with the second focused on updates (Actions). Pairs peer-review work via GitHub pull requests before a lead approves and merges the code. This creates a rhythm of roughly one component or container finished every two weeks, while gradually increasing task difficulty.

We have deployed this program since 2020, allowing us to observe the trajectories of dozens of students in becoming full research lab members. To evaluate the program's efficacy, we conducted semi-structured interviews with 12 program members over 2024-2025 [2]. Thematic analysis of interviews highlighted the micro-role-based structure scaffolded a manageable and motivating pathway for students, enabled collaborative peer work, and cultivated an empowering environment. However, these interviews also helped us identify key weaknesses that led us to evolve our program's design (e.g., an overemphasis on task completion could hinder deep learning or lead to an overreliance on AI tools). The qualitative study also helped us to understand how people navigate learning "on-the-job". For example, while students tend to start by closely following step-by-step worked examples [9] in a dynamic of imitative task completion, they soon transitioned to a dynamic of "learning through differences," in which learners no longer wanted to use detailed walkthroughs, but instead looked for ways to compare new tasks against previously accomplished tasks.

Coordinating a large consultancy project from qualitative analysis to prototypes in a class

As we began to develop micro-roles to align education with real-world practice in our research lab, we also considered how we might use micro-roles in the classroom. Unlike the research lab setting, where there can be different cohorts of students progressing through different parts of the pathway and mentoring earlier cohorts, courses are constrained by a bounded timeline in which a single cohort of students moves through the quarter together. This led us to shift our concept of micro-roles from primarily being used to link role hierarchies with learning pathways to any role-based structures that can help link education to real-world practice.

Our idea was that micro-roles could enable us to organize a class of over 100 students around a substantial consultancy project for a non-profit partner [3]. Over the 10-week quarter, students conducted and analyzed a large set of stakeholder interviews, then split into smaller teams to prototype solutions addressing identified needs. Students were organized into teams responsible for different aspects of the project. Assignments were framed as micro-roles, and a Gantt chart visualized role-specific deadlines across the quarter.

Weekly sections functioned as work sessions for team deliverables, lectures were repurposed for modeling, critique, and class discussion, and TAs/tutors adopted management-like roles through regular check-ins in which they provided feedback on project work and team dynamics.

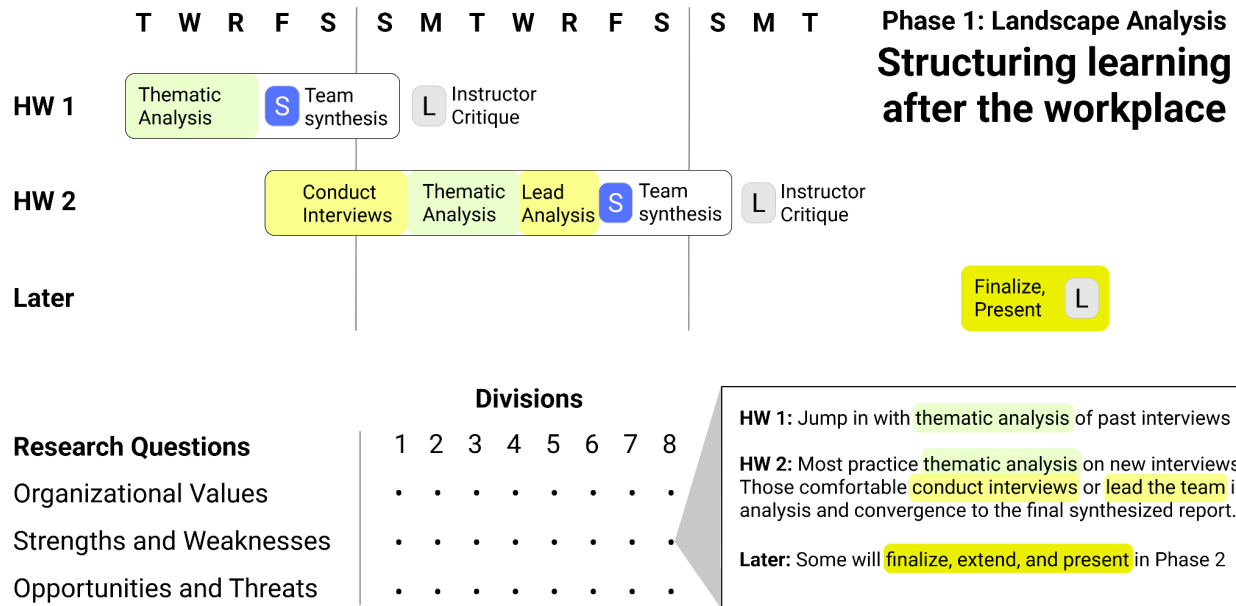


Figure 2. During the landscape analysis and stakeholder experience phases, students are organized into divisions composed of three teams addressing distinct research questions. Students start in Week 1 by analyzing interviews that the course staff had already conducted. Then they split up into different micro-roles to conduct, analyze, and synthesize a new set of interviews in the second week.

The first several weeks of the course centered on conducting and analyzing interviews to understand both internal and external perspectives of the organization (**Figure 2**). Typically, in classes where students go from user research to prototyping in a single quarter, students' engagement with end users and clients is limited and confined to requirement-gathering instead of sustained qualitative inquiry [7]. Our micro-role structure, however, engaged students in a rigorous qualitative analysis process [11], [12]. Students began by analyzing interviews conducted by the course staff to build intuition, then conducted, analyzed, and synthesized a new set of interviews the following week by dividing across research questions and roles. Students who demonstrated strong performance in the first week took on leadership roles in the second.

At the end of this course, students were invited to optional, semi-structured interviews. The 10 student interviews conducted were then analyzed through an inductive, reflexive thematic analysis process. We will synthesize the core qualitative findings from the original analysis [3]. Students reported that experiencing a large project 'end-to-end' helped contextualize their role and the purpose of their work. Students noted that they didn't initially understand the qualitative analysis was "*leading up to*" or its value, but later saw everything "*coming to action*" in the latter half of the course when students engaged in design explorations of potential solutions to help the non-profit, which helped them realize the value of their work. The project's authenticity and its connection to stakeholders fostered motivation, as students reached a point where "*transcripts actually lead to a cohesive idea*", reinforcing qualitative analysis' value as a tool for real-world impact that serves a functional purpose. Students valued the layered support structures embedded in the course. Regular check-ins with course staff provided management guidance and helped facilitate productive team dynamics. Sections reframed as collaborative work sessions supported peer knowledge sharing, role modeling, and mutual problem solving. Together, these structures balanced limited staff time with the need for personalized and scalable support.

Towards micro-role structures that link education, practice, and community engagement

Our findings across research lab and classroom settings suggest that micro-role structures offer a path for bridging higher education and real-world practice. By reframing courses and learning programs as collaborative organizations, we move away from the model of individual, disparate assignments towards a model of learning that is situated in authentic, real-world practice.

We see micro-role-based learning as an opportunity to bring “on-the-job” learning dynamics into education as a pedagogical model. Whereas “on-the-job learning” is traditionally a term associated with corporate training of new employees who need to learn on-the-job [4], [8], we see it as an equally valuable dynamic in traditional higher education, emphasizing the need to organize learning around significant real-world projects and professional practices. Figuring out how to do so successfully will also enable richer community-engaged learning in which students can contribute to and learn about community issues in the course of building technical, design, and leadership skills.

Realizing this vision will require new research on the design of organizational structures that center learning rather than productivity, on how to support and design learning in this environment in a pedagogically sound way, and on new tools and learning management systems that help to orchestrate micro-roles, support mentorship, and facilitate collaboration in teams and across classrooms.

It will also help us to move closer to John Dewey’s vision of education as inseparable from community life [5], [6]. Education that is situated in and flows from real life, developing individuals to their full capacity for contributing to society, and communities that can rely on education to help individuals recognize their obligations to one another and society.

Acknowledgements

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