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Preparing Human Factors Graduate Students to Be Human Factors Professionals

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ABSTRACT

The multi-disciplinary nature of human factors requires a range of knowledge and skills concerning academic theories and methodologies to be acquired by students in human factors programs. Universities develop these academic and technical skills and knowledge but is this set of competencies all that is needed for the students' success as human factors professionals? In the Master of Science Human Factors program at California State University, Long Beach, we require a course titled Practicum in Human Factors where second-year graduate students are placed in professional settings as human factors interns in paid or non-paid positions, practicing being a professional. The students participated in weekly seminars as well as work for 10 to 20 hrs. per week in their practicum placements. Students wrote weekly reflections on the important lessons they are learning in their practicum placement and seminar. The total of 182 essays were subjected to a qualitative analysis to identify the emergent concepts the students thought they were learning which were essential for their success in their professional placements. Eleven (11) emergent concepts of the skills and knowledge the students identified as important to their development as a human factors professional were produced by the qualitative analysis. Ten (10) of the emergent concepts were related to project management in dynamic situations and career planning and growth. Only one was focused specific to human factors methods. Experiencing the changing and unexpected demands within the workplace enables students to practice their problem-solving and project management skills as well as developing resilience in maintaining a positive outlook within dynamic and often challenging circumstances. Providing regular opportunities for students to reflect on their professional employment skills helps them recognize and prepare for the challenges they will face in their early careers.

Keywords: Human factors curriculum, Practicum, Internships, Workplace skills, Human factors professional competencies

INTRODUCTION

Across the last decade, guidance from professional societies and standards bodies has converged on a coherent set of learning objectives for graduate-level Human Factors/Ergonomics (HF/E). The Human Factors and Ergonomics Society's (HFES) current accreditation guide organizes the

curriculum around three core areas—(1) understanding human capabilities and limitations; (2) skill in evidence-based HF/E methods; and (3) knowledge of application domains—supplemented by requirements for communication, teamwork, research/practical experience, and a survey course in HF/E. Programs are expected to provide at least 12 graduate credits spanning the three core areas (in addition to a survey course) and to cultivate collaboration and communication competencies. This framework explicitly lists foundational topics (e.g., information processing, perception-action, anthropometry, biomechanics, cognitive science) and emphasizes structured method training and domain knowledge (e.g., healthcare, transportation, consumer products), thereby setting clear outcomes for what graduates should know and be able to do (Human Factors and Ergonomics Society, 2021).

The International Ergonomics Association's (IEA) 2021 Core Competencies further elaborate a competency-based model that maps cleanly onto HFES's structure. The IEA defines seven units of competence: foundation knowledge; measurement and analysis; evaluation; recommendation; implementation; scientific skills; and professional skills. The competencies stress a systems perspective, human-centered and iterative design, stakeholder engagement, and dual aims of performance and well-being. For master's programs, these translate into learning objectives that integrate theory (e.g., perceptual/cognitive/biomechanical bases) with practice (e.g., study design, data collection/analysis, design critique), culminating in the ability to analyze complex socio-technical systems and influence design decisions (International Ergonomics Association, 2021).

Foundational human-centered design (HCD) objectives. ISO 9241–210 formalizes HCD principles and activities across the development life cycle. Master's graduates should be able to plan and execute HCD processes: understand and specify the context of use; derive user requirements; produce design solutions; and evaluate against requirements—iteratively and with users. Programs that align learning outcomes to ISO 9241–210 help graduates speak a common process language with designers, engineers, and regulators and equip them to embed HCD in organizational practice (International Organizations for Standards, 2019).

Methodological proficiency and evidence standards. Both HFES and IEA underscore methodological breadth: task analysis, contextual inquiry, ethnography, cognitive walkthroughs/heuristic evaluation, prototyping, experimental design, survey design, physiological/behavioral measurement, and statistical analysis. Graduates should be able to select and tailor methods to constraints, design defensible studies, manage bias, analyze qualitative and quantitative data, and communicate evidence to non-specialists. The IEA's competency units explicitly require measurement/analysis and evaluation skills, while the HFES accreditation guide requires "skills in carrying out evidence-based HF/E methods" and demonstrable research/practical experience (e.g., thesis, capstone, internships), reinforcing applied rigor as a learning objective (International Ergonomics Association, 2021).

Systems thinking and domain integration. The IEA emphasizes that HF/E is design-driven and systemic: practitioners must situate human

performance within organizational, environmental, and cultural contexts. Graduate objectives therefore include the ability to scope systems, model user journeys/workflows, map stakeholders, and weigh trade-offs among safety, efficiency, accessibility, and sustainability. HFES's "application domains" requirement ensures students can transfer methods to real sectors such as healthcare, transportation, defense, and consumer tech (International Ergonomics Association, 2021).

Communication, teamwork, and professional practice. Effective HF/E practice depends on multidisciplinary collaboration. HFES explicitly requires programs to teach teamwork and communication (written and oral), and to provide experience working in groups with structured feedback. The IEA's "professional skills" unit spans ethics, project management, stakeholder engagement, and the ability to influence decision-makers—objectives that master's curricula increasingly embed via studio courses, client-based projects, and capstones (Human Factors and Ergonomics Society, 2021).

Regulatory and standards literacy (sector-specific). In regulated domains—especially medical devices—graduates need working familiarity with the usability engineering process defined by IEC 62366–1 (including planning, risk-based analysis of use errors, formative and summative evaluations, and usability engineering files) and with FDA guidance that recommends integrating human factors throughout device development and submitting appropriate HF validation evidence. While not universal across all HF/E programs, sector-focused tracks increasingly include these outcomes so graduates can step into industry roles requiring compliance-oriented documentation and study execution (International Electrotechnical Commission, 2015).

Program design and assurance. Finally, HFES accreditation guidance treats graduate HF/E programs as interdisciplinary entities (often housed in engineering or psychology) and expects sufficient faculty depth, resources, and a survey course that orients students to the breadth of HF/E. For learning objectives, this means programs must balance breadth (survey and core coverage) with depth (method mastery and domain specialization), produce artifacts demonstrating competence (e.g., portfolios, reports), and cultivate readiness for certification or professional practice (Human Factors and Ergonomics Society, 2021).

In sum, essential learning objectives for HF/E master's programs are (1) foundational human sciences knowledge; (2) proficiency with a suite of empirical and design methods aligned to ISO 9241-210; (3) systems thinking applied to domain problems; (4) communication, teamwork, and ethical/professional practice; and (5) (where relevant) literacy in sector standards/regulations such as IEC 62366–1 and FDA human factors guidance. Collectively, HFES and IEA documents provide the clearest, consensus-driven articulation of these outcomes and how programs can evidence them through coursework and practice (U.S. Food and Drug Administration, 2016, 2023).

California State University Long Beach: Master of Science in Human Factors. The two-year, 30-unit graduate program in human factors within the Psychology Department at California State University has been preparing

students for the human factors profession for over 25 years. The curriculum is well-aligned with HFES and IEA standards and guidelines (CSULB MSHF, 2025). Most of our students transition to human factors jobs in industries upon graduation. The human factors faculty recognize that preparing our students for success in the workplace, and not just the classroom or lab, is an essential ingredient for their future successes.

Our CSULB program has a required course titled Practicum in Human Factors which involves second year students being placed in a professional setting as human factors interns in paid or non-paid positions. Their responsibilities are focused on applying their human factors academic knowledge and skills to address business challenges that their industry placement has identified. Recent industry placements include research centers on automobile designs, design companies for medical devices, user-interface design companies, educational technology companies, forensic human factors companies, aerospace companies, and public attractions wanting to improve patron navigation through their physical facilities. The students participated in a weekly seminar as part of the practicum course as well as 10 to 20 hrs per week in their practicum placements.

Our Research Question: "What are the skills that students identify as essential for their success in the practicum workplace?" With the students' initial entry into the workplace, what do they see as the critical skills they need to be successful? Students identifying their "gaps" in their preparation for the workforce can be important information for CSULB's continuous improvement of our curriculum and can provide useful recommendations for other human factors programs.

METHODOLOGY

One of the practicum course assignments was for each student to write a weekly reflection on the lessons they were learning in their practicum placement and seminar, describing key concepts and strategies for being successful in their early experience as a human factors professional. During one semester, fourteen reflections were written by thirteen students, producing 182 essays (over 35,000 words). The collection of essays was subjected to a qualitative analysis to identify the emergent concepts (themes) with subordinate concepts (codes) to identify the skills and knowledge the students thought they were learning in their practicum placements and seminar. Intellectus Qualitative (2025) was the qualitative analysis technology used to support the content analyses of the essays. This tool integrates Gen AI analyses with statistical cluster analyses to generate the emergent concepts and subordinate concepts that are pervasively represented in the students' essays.

RESULTS

Table 1 provides a summary of the eleven emergent concepts of the skills and knowledge the students identified as important to their development as a human factors professional. It is important to note that ten of the

key concepts were not related to specific human factors methodologies (e.g., heuristics analysis, user testing, signal detection, task analysis, etc.). Only one, Understanding User Needs, aligns with specific human factors methodologies. The key concepts were connected to 1) problem solving and managing projects in dynamic environments and 2) learning about their own career planning and professional growth.

	Name and Description of Key Concepts Present In Student Reflections on Practicum Experiences
1.	**Adaptability And Flexibility:** The need to be flexible and adapt to changing circumstances throughout project lifecycles.
2.	**Resilience To Workplace Challenges:** Learning to be flexible and resilient when facing unexpected workplace situations.
3.	**Career Planning And Development**: Reflections on career goals, job satisfaction, and professional growth opportunities.
4.	**Communication In The Workplace:** The importance of clear, effective communication strategies with colleagues and stakeholders, especially when seeking help and establishing expectations.
5.	**Networking And Professional Connections:** Building professional networks and relationships for career development and opportunities.
6.	**Professional Growth:** Insights about personal and professional development through practical experiences.
7.	**Project Management Challenges:** Navigating deadlines, scope, resources, and expectations in professional projects.
8.	**Team Dynamics:** Experiences of working within established teams and adapting to team structures.
9.	**Time Management**: Challenges and strategies related to managing time effectively when dealing with multiple responsibilities.
10.	**Understanding User Needs:** The significance of centering user experiences and needs when designing technological solutions.
11.	**Workplace Structure:** The importance of understanding organizational structure and roles within a company.

DISCUSSION

The qualitative analysis of the students' reflections on the important skills they learned in practicum provided important insights on how academic programs need to prepare human factors student to be successful human factors professionals. The HFES requirements for communication, teamwork, and professional practices are ambiguous and these 11 skills provides greater specificity for designing curriculum and learning assignments across a program's courses.

The qualitative analysis provides important guidance for academic programs in human factors to prepare their students for success in the workplace. First, including practicum experiences within the program enables the students to experience and practice the professional skills for project management. For many students, the practicum was their first exposure to the workplace environment; where the emphasis on

communication, project management, and teamwork skills were even more important than their technical skills because they needed to learn, align, and contribute to the social-organizational structure of the workplace. Experiencing the changing and unexpected demands within the workplace enables students to practice their problem-solving skills and mindsets as well as developing resilience in maintaining a positive outlook within dynamic and often challenging circumstances. The cognitive, affective, and social dimensions of a complex workplace environment provide students with a rich context for solving problems for their company or clients and for exploring career development opportunities and preferences.

The second outcome of these findings is the analysis helps students identify the skills employers will be looking for in new candidates that could mature into more senior positions. We reviewed the top ten skills most frequently required in Senior Human Factors Engineer job announcements (2024–2025). Derived from a cross-section of current postings (Apple; Medtronic; Intuitive; Medline; Sandoz; GlobalLogic healthcare; plus, representative boards), these were selected to reflect both regulated and non-regulated contexts and to emphasize skills that recur across listings. The following skills appear most consistently:

1. Lead end-to-end human-centered design/research programs.
2. Design and run formative and summative/validation usability studies.
3. Conduct task analysis and derive user/system requirements,
4. Execute use-related risk analysis and integrate with risk management, FMEA where applicable.
5. Demonstrate literacy and compliance with standards/regulations.
6. Apply strong experimental design and statistics.
7. Collaborate across disciplines and influence stakeholders.
8. Prototype and evaluate UI/UX concepts.
9. Excellent written and verbal communication
10. Mentor/coach and drive HF practice maturity.

Many of these senior-level skills require foundational project management, resiliency, flexibility, time management, managing team dynamics, networking, understanding organizational structures and more. Gaining experience in these foundational skills can help graduates explain how they have successfully handled stressful situations and tight timelines; how they communicated effectively with the human factors team as well as other team members in the company; and how their approach to project management, including strategies for responding to the dynamics of a project plan, is aligned with the rest of the team. The students can begin to recognize their "employability skills" and communicate them in letters of application, resumes, and interviews that lay a foundation for career progressions with the employer.

Finally, providing regular opportunities for students to reflect on their learning of professional employment skills in the seminar helped them recognize and prepare for the challenges they will face in their early careers. The opportunities for sharing these reflections with their peers and their

faculty instructors gave them practice problem solving the challenges they face and maintaining a positive and resilient mindset through the social support of the practicum course. With a richer preparation of project management and career management skills, students will be able to advance their careers with fewer setbacks.

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