WIP: MotoVida Challenge: A First-Year Humanitarian Design Curriculum Integrating EE/ME Skills

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Abstract

This Work in Progress (WIP) paper presents a two-course first-year engineering sequence in which an introductory course (EGR 120 Engineering Explorations) and a follow-on course (EGR 130 Introduction to Engineering Design) are aligned through a common humanitarian engineering theme called the MotoVida Challenge. The project name, coined by the authors as a portmanteau of "moto" (motor vehicle) and "vida" (Spanish for "life"), conveys the central premise: a motor vehicle that can save lives in remote, underserved communities. (The name is internal to this curricular initiative and is unrelated to any commercial product or apparel brand using a similar word.) Rather than a single yearlong project, each course features a distinct design project (a robotics project in EGR 120 and an industry-partnered humanitarian project in EGR 130), with curricular scaffolding that connects the two. EGR 120 culminates in a project where teams modify the structure and programming of an Elegoo robot car to follow lines and collect ping-pong balls using their first-year programming and Computer-Aided Design (CAD) skills. EGR 130 culminates in the MotoVida humanitarian challenge, in which teams design and modify a prototype ATV in partnership with OSF HealthCare to function as an emergency-response micro-ambulance for rural communities, motivated by a need observed by faculty collaborators working with a remote community in Brazil. The intentional curricular alignment and scaffolding emphasize early development of design, communication, ethical reasoning, and teamwork skills aligned with ABET student outcomes 2 to 5. Because this initiative is offered to the entire entering cohort of a newly founded engineering college that intentionally serves a diverse and inclusive student population, the work also speaks to the engagement of first-year learners with varied backgrounds and prior preparation. This paper reports the design rationale, curricular structure, and publicly observable outcomes of the inaugural implementation in Academic Year 2025–2026, including the inaugural Freshman Engineering Design Project Symposium held in late April 2026 and a synthesis of evidence of EE/ME integration visible in publicly displayed student design posters. Full student deliverables (final reports and reflections) become available after EGR 130 concludes in May 2026; this paper does not present an analysis of student-generated data, and a more comprehensive evaluation will follow in future work.

Keywords: first-year engineering education, humanitarian engineering, project-based learning, industry partnership, ABET student outcomes, engineering identity, work in progress

Introduction

Engineering educators have increasingly recognized the importance of engaging students with real-world, socially relevant design problems early in the curriculum. Traditional programs that postpone design experiences until a senior capstone can leave first-year students disconnected from the broader impacts of engineering. Cech [1] reported that engineering students' concern for public welfare issues tends to decline significantly over the course of their education, reflecting a "culture of disengagement" in which purely technical concerns are prioritized over social context. By embedding societal and ethical considerations into coursework from the start, engineering programs may counteract this trend and produce more socially conscious engineers. First-year design projects with humanitarian themes are a promising response, aiming to sustain students' initial motivation to make a positive impact through engineering [2, 3].

There is also a broader pedagogical shift toward active, project-based learning in first-year engineering education. Early exposure to open-ended design keeps students' excitement high and builds confidence in problem-solving [4, 5]. Masten and Fleisig's first-year course is one notable example: students tackled Engineers Without Borders–inspired projects that demanded technical solutions and consideration of community health, safety, and sustainability [2]. Similarly, the Engineering Projects in Community Service (EPICS) program has integrated community-based projects into engineering curricula to engage students in socially relevant problem-solving [3]. Dym et al. [6] argue that engaging freshmen in meaningful design problems from day one is crucial for developing effective engineers, and authentic, client-driven framing has been shown to deepen the learning value of such projects [7].

This paper presents an integrated first-year curricular model that combines two first-year engineering courses into a cohesive sequence centered on a humanitarian design theme. At the College of Engineering of Illinois State University, a newly founded program whose inaugural cohort is intentionally drawn from a broad, diverse pool of students, including significant representation from first-generation, underrepresented, and rural-Illinois backgrounds, we designed our introductory engineering sequence (a two-semester sequence of EGR 120 in fall and EGR 130 in spring) to implement the MotoVida Challenge. "MotoVida" is a portmanteau coined by our team from "moto" (motor vehicle) and "vida" (Spanish for "life"); the name conveys the project's aim of designing a motor vehicle that can save lives in emergency scenarios, and is not associated with any commercial brand of the same word. Each team of 3–5 students integrates Arduino microcontrollers, sensors, and mechanical components into their solution, applying fundamental concepts from electrical/computer and mechanical engineering. The MotoVida concept is grounded in real-world need. The EGR 130 MotoVida project challenges student teams, in partnership with OSF HealthCare, to convert a rugged 4×4 utility vehicle into a stretcher-capable micro-ambulance for environments where conventional ambulances cannot reach. The project draws motivation from a faculty–medical collaboration with the Guaraní-Jaraguá community in Brazil, alongside use cases closer to home, rural Illinois communities, snow-bound conditions, and mass-casualty events such as multi-vehicle pileups involving 100 or more vehicles. The approach is mapped to ABET student outcomes 2–5 (design in context, communication, ethical/professional responsibility, teamwork) so these competencies are introduced and developed in the first year.

Program Context and Rationale

Prior to the MotoVida integration, the first-year engineering curriculum at our institution consisted of two largely separate courses. EGR 120 (Engineering Explorations, fall) provided an overview of engineering disciplines, an introduction to the design process, and basic technical skills. It culminated in a robotics mini-project: student teams assembled and programmed a simple autonomous Arduino-based rover. Students learned CAD using Onshape, used Fused Deposition Modeling (FDM) 3D printing and laser cutting, wrote code, wired circuits, and worked in teams. While the project successfully built technical competency, it focused on the mechanism itself, with limited explicit attention to social context. End-of-course feedback from past iterations indicated that some students found the project enjoyable but disconnected from "real" engineering problems with human impact, echoing findings in the literature that purely technical projects without a social context may fail to resonate with students' desire to make a difference [8].

EGR 130 (Introduction to Engineering Design, spring) builds on the technical skills developed in EGR 120 and adds advanced CAD, including assemblies, motion studies, and hands-on mechanism development. Historically, the EGR 130 design exercise was unrelated to the fall course. The latest ABET accreditation criteria encourage programs to introduce ethical and professional considerations throughout the curriculum from the first year [9], and national reports such as The Engineer of 2020 [10] emphasize that modern engineers need broad awareness of societal and global contexts as well as teamwork skills. We also wanted to better motivate students entering with altruistic goals or a desire to "make a difference," and we hypothesized that reframing the project around a humanitarian challenge, paired with an authentic industry partnership, could broaden its appeal and highlight engineering's relevance to societal needs. These motivations drove the creation of the MotoVida Challenge, a community-centered design sequence intended to retain the benefits of the prior curriculum (active learning, teamwork, fundamental skill-building) while addressing its limitations.

A Sequential First-Year Curriculum Scaffolded Through a Humanitarian Design Challenge

EGR 120 and EGR 130 are distinct courses with separate design projects; the integration is curricular alignment and scaffolding, not a single continuous project. Each course features its own project while sharing a common humanitarian context, EE/ME integration goal, and learning objectives.

EGR 120: Foundations in Fall (Robotics Project)

The fall course builds students' core technical skills and introduces the humanitarian theme in a scaffolded way. Students participate in two weekly 75-minute hands-on labs, one led by an electrical/computer engineering instructor and one by a mechanical engineering instructor. Lab activities include hands-on circuit building with LEDs, resistors, and multimeters to measure voltage, current, and resistance; Arduino programming; 2D/3D CAD modeling; 3D printing; and prototyping. Mini design challenges spark creativity and teamwork; for example, a tower-building exercise has teams design a small paper tower to survive an "earthquake" on a shake table, and a brainstorming activity asks "How could engineering help in a disaster scenario?" to foreshadow the spring project.

Midway through the fall, teams of about four undertake a robot car project as the capstone of EGR 120. In Fall 2025, teams enhanced a basic Elegoo Arduino robot car to collect and deposit small objects (simulating medical supplies) in a target area. Students integrated a line-tracking sensor with a servo-actuated, 3D-printed bucket mechanism, developing Arduino code to coordinate sensor input, motor control, and servo actuation. Students encountered technical obstacles (e.g., inconsistent line detection, limited servo torque, ball slippage) and addressed them through iterative testing and refinement. EGR 120 also includes an industry-engagement element: an inventor and entrepreneur (a benefactor of the College of Engineering with industry leadership experience in design) joined the class as a guest speaker, sharing professional experience with first-semester students.

EGR 130: Humanitarian Project in Spring (MotoVida)

In EGR 130, students form new teams of 3–4 and develop an emergency-response solution. The MotoVida scenario was developed through a collaboration between engineering faculty and a medical team that visited the Guaraní-Jaraguá community in Brazil to provide medical support. In that community, conventional ambulances cannot reach patients during emergencies such as snakebites or pregnancy complications, and a custom utility vehicle could fill the gap. A scaled prototype UTV, sponsored by OSF HealthCare, is integrated into the project, and student teams design accommodations for the patient and a medical storage cabinet at the rear of the ATV. Each team further defines a particular sub-problem (e.g., transporting an injured person when roads are impassable, or designing a stretcher attachment to convert the vehicle into a micro-ambulance). All teams operate under a uniform $150 per-team materials budget, draw parts from a constrained vendor list (Amazon, McMaster-Carr, DigiKey) on two pre-scheduled order dates, and use shared lab resources (3D printing in PLA, laser cutting, and standard electronics components).

Teams enter a 5–6 week design-research phase: they gather background information and engage with stakeholders or subject-matter experts (rural community health workers, emergency responders, medical and engineering faculty, and industry mentors from the project sponsor). To frame this work, we introduce Asset-Based Community Development (ABCD) [11] and cultural-humility principles, asking teams to list community assets they plan to leverage, not just problems to solve. Reflection prompts, planned for further iterations, will gauge students' perceptions of power dynamics and community voice. By around week 7, each team produces a Problem Definition and Requirements document. In parallel, intensive lab modules reinforce and extend EGR 120 skills: sensor interfacing (e.g., GPS), Solar recharging systems, data-acquisition circuits for different sensors, advanced microcontroller programming, intricate CAD assemblies and motion studies, and planar/motion-transfer mechanism design. Teams then move into ideation (using techniques such as Crazy 8s sketching), select a concept after instructor feedback, and spend the bulk of the semester building and iterating on a functional prototype. Each project must integrate multiple sensors, an Arduino-based control system, and custom-fabricated mechanical components, and must operate under realistic conditions. Mid-semester design reviews provide formative assessment.

The semester culminates in a university-wide design symposium attended by university leadership, industry professionals, faculty, and invited guests; teams present a live prototype demonstration, design poster, design book, and a formal oral presentation. The symposium is judged by a mixed panel including faculty and industry professionals from a major regional employer, reinforcing the authenticity of the design experience [7]. A key limitation of the inaugural pilot was the absence of direct community participation and formal stakeholder evaluation. Future iterations will explore feasible pathways to incorporate these elements, consistent with ABCD principles, to guard against unintended paternalism.

Inaugural Implementation: Spring 2026 Design Symposium

The inaugural cohort of the College of Engineering completed the EGR 120–EGR 130 sequence in Academic Year 2025–2026. As publicly reported by the institution’s news office [12], approximately 140 first-year students presented hands-on design projects on April 27, 2026 at the inaugural Freshman Engineering Design Project Symposium. Students presented to an industry partner in teams of three or four on the MotoVida emergency-response ATV concept, designed for deployment in remote settings such as rural and rainforest terrain. Judges from across campus and external partners (including a major regional industrial employer) circulated through the showcase, evaluating teams on creativity, visual design, and presentation. The university president, provost, and dean of the College of Engineering attended the symposium and recognized the cohort's first-year achievements [12]. Awards on the MotoVida track went to the winning teams Mad Cadders (first), Save South America (second), and the Medical Emergency Response Transport Team (third) [12, 13]. Project descriptions reported in the institutional news coverage, such as an autonomous, dusk-activated light bar; an integrated medication-storage compartment; and an improved stretcher-loading system, indicate that teams produced multi-domain solutions that integrated electrical sensing and actuation with mechanical fabrication, consistent with the curriculum's EE/ME integration goals [12].

Diversity of EE/ME Solutions in Public Design Posters

Across the inaugural cohort, MotoVida teams produced a striking diversity of solutions, all integrating both electrical and mechanical subsystems within the shared materials budget and the eight-week design timeline. Mechanical sub-systems explored across teams included multiple distinct canopy and rain-protection approaches: retractable telescoping canopies with gear-driven extension, PVC-and-clamp adjustable frames, fixed roll-bar canopies covered with waterproof tarps, and sloped membrane canopies with integrated drainage, reflecting genuinely different mechanical design strategies for the same functional requirement. Patient-loading mechanisms ranged from winch-and-rotating-crane systems mounted to the trailer hitch, to scissor-lift gurneys with reinforced linkages, to stretcher cradles paired with foldable loading ramps and modular mounting clips. Medical-storage subsystems included vibration-isolated medicine cabinets, modular drawer systems with removable cooling components, and stackable fridge organizers that accommodated weight or fill-status sensing. Mounting and locking systems, used to secure modules to the ATV bed, ranged from rail-and-block configurations with pin locks (sourced as off-the-shelf hardware after iteration) to three-piece pin-and-buckle locking assemblies.

Electrical subsystems showed comparable breadth. GPS-tracking implementations included Arduino-driven NEO-6M modules with LCD coordinate readouts, fully self-contained SD-card data loggers (capturing time, latitude, longitude, altitude, and satellite count for offline pathing analysis), and Wi-Fi-enabled trip-charting systems built around small Wi-Fi modules. Autonomous lighting solutions used several sensing modalities for activation: thermal-IR sensing of warm bodies, ultrasonic sensing of canopy position to trigger interior LEDs, and light-dependent resistor (LDR) sensing of ambient luminosity to recommend or activate auxiliary ditch lights. Medication-tracking subsystems explored distinct sensing approaches, including NFC-based tag reading for individual medication items, weight-based pressure sensing with color-coded fill-status LEDs (red/yellow/green), capacitive touch-sensor slot detection, and motion-sensor-based slot-occupancy tracking. Several teams added complementary environmental sensing (temperature and humidity) to inform vehicle operators about safe travel conditions, and one team integrated H-bridge MOSFET motor control with an IR remote to drive a 12 V crane-and-winch loading mechanism.

Recurring design-process insights surfaced across team posters as well. Teams iterated through low- to mid-fidelity prototypes, typically beginning with cardboard or laser-cut wood for early validation and migrating to PLA-printed or off-the-shelf hardware for the final build, and several teams documented specific lessons: cardboard's unsuitability for repeated load-bearing use; the value of foam padding in stretcher and patient-handling subsystems; the limited memory headroom of low-cost microcontrollers when polling multiple NFC readers on short cycle times; and, in some cases, the practical advantage of purchased pins, clamps, and washers over fully 3D-printed mechanical hardware for reliability. The diversity of approaches, across canopy, lighting, GPS, medication-tracking, and loading subsystems, illustrates that the curriculum's EE/ME integration goals are being met through team-driven design choices rather than prescribed solutions, while the shared budget, vendor list, and lab resources keep the design space tractable for first-year students.

Discussion

The first-year sequence has so far achieved its primary structural goals: every team in the inaugural cohort produced a working prototype that was presented at a public symposium attended by university leadership, the industry partner, and external judges [12]. The diversity of EE/ME approaches visible in publicly displayed design posters, multiple distinct canopy mechanisms, several GPS-tracking implementations, four or more medication-tracking sensing modalities, and varied patient-loading strategies, indicates that students engaged with the project as an open-ended design problem rather than a recipe, consistent with Dym et al.'s [6] argument that novices, with appropriate scaffolding, can tackle meaningful design problems early. The participation of OSF HealthCare as project sponsor, the inclusion of an industry-rich judging panel, and a benefactor-inventor as a guest speaker in EGR 120 collectively operationalize the call in the literature for authentic, client-driven first-year design experiences [7].

Importantly, this initiative is being deployed at a newly founded engineering college that recruits and serves a diverse first-year cohort, with substantial representation from first-generation, underrepresented, and rural-Illinois students. Anchoring the entire entering cohort's design experience in a humanitarian context is itself a diversity-relevant pedagogical decision: prior literature suggests that contextually rich, service-oriented projects can improve motivation and retention of underrepresented students by aligning with their values and sense of social purpose [14]. Our framing of the MotoVida project around an underserved community context, paired with explicit ABCD discussion, is intended to support engagement across this diverse cohort. The student-nominated 2026 Impact Award, which recognized faculty teaching the sequence [13], offers an early institution-level signal that the program's emphasis on individualized attention and faculty-student collaboration is being noticed by students themselves.

Several aspects warrant continued attention. First, our reflection prompts on power dynamics and community voice are a first step; future iterations will explore the options for integrating community stakeholders, consistent with ABCD principles, to guard against unintended paternalism. Second, this paper draws only on publicly observable artifacts (the symposium, institutional press, publicly displayed design posters, and an institution-level recognition); a richer empirical understanding of how the curriculum supports development of design self-efficacy, engineering identity, and ABET-aligned competencies will require evaluation of student deliverables that become available at the conclusion of EGR 130, conducted under appropriate institutional review.

Conclusions and Next Steps

In its first year of implementation, the sequential EGR 120–EGR 130 curriculum, culminating in the MotoVida Challenge in EGR 130, has shown promise as a model for engaging and educating first-year engineering students. Public symposium outcomes and the technical breadth of solutions visible in design posters collectively suggest that the two-course, humanitarian-focused, industry-engaged model is viable and well-received in its inaugural deployment. The framework is readily transferable: another institution could adopt a similar structure by selecting (a) a humanitarian project theme relevant to its context, (b) one or more authentic industry or community partners, and (c) a coordinated assessment plan spanning both technical and professional outcomes.

Looking ahead, full student deliverables, final design reports, and reflections will become available after EGR 130 concludes in May 2026. We will analyze these materials in a subsequent publication, examining design self-efficacy, engineering identity, and ABET-aligned competency development; that subsequent study will be conducted under appropriate institutional review. By sharing our experiences and early implementation observations now, we aim to contribute to the growing evidence that first-year engineering education can be both foundational and inspirational when it connects the head, hands, and heart of engineering practice.

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References

[1] E. A. Cech, “Culture of disengagement in engineering education?” Science, Technology & Human Values, vol. 39, no. 1, pp. 42–72, 2014.

[2] S. J. Masten and R. V. Fleisig, “Engaging first-year students in engineering design through Engineers Without Borders projects,” in Proc. ASEE Annual Conference & Exposition, Pittsburgh, PA, 2008, Paper AC 2008-230.

[3] E. J. Coyle, L. H. Jamieson, and W. C. Oakes, “EPICS: Engineering Projects in Community Service,” International Journal of Engineering Education, vol. 21, no. 1, pp. 139–150, 2005.

[4] M. J. Prince and R. M. Felder, “Inductive teaching and learning methods: Definitions, comparisons, and research bases,” Journal of Engineering Education, vol. 95, no. 2, pp. 123–138, 2006.

[5] D. W. Knight, L. E. Carlson, and J. F. Sullivan, “Improving engineering student retention through hands-on, team-based, first-year design projects,” in Proc. 37th ASEE/IEEE Frontiers in Education Conference, Milwaukee, WI, 2007, pp. T2H-1–T2H-6.

[6] C. L. Dym, A. M. Agogino, O. Eris, D. D. Frey, and L. J. Leifer, “Engineering design thinking, teaching, and learning,” Journal of Engineering Education, vol. 94, no. 1, pp. 103–120, 2005.

[7] A. R. Bielefeldt, K. G. Paterson, and C. W. Swan, “Measuring the value added from service learning in project-based engineering education,” International Journal of Engineering Education, vol. 26, no. 3, pp. 535–546, 2010.

[8] J. Lucena, J. Schneider, and J. A. Leydens, Engineering and Sustainable Community Development. San Rafael, CA: Morgan & Claypool, 2010.

[9] ABET Engineering Accreditation Commission, Criteria for Accrediting Engineering Programs, 2019–2020. Baltimore, MD: ABET, 2018.

[10] National Academy of Engineering, The Engineer of 2020: Visions of Engineering in the New Century. Washington, DC: National Academies Press, 2004.

[11] J. P. Kretzmann and J. L. McKnight, Building Communities from the Inside Out: A Path Toward Finding and Mobilizing a Community’s Assets. Evanston, IL: Institute for Policy Research, 1993.

[12] K. Bersett, “Design symposium showcases engineering students’ innovative solutions to real-world problems,” Illinois State University News, April 28, 2026. [Online]. Available:

https://news.illinoisstate.edu/2026/04/design-symposium-showcases-engineering-students-innovative-solutions-to-real-world-problems/

[13] Illinois State University College of Engineering, official social-media announcements, April 2026.

[14] J. J. Duffy, L. Barrington, and M. A. Heredia, “Attitudes of engineering students from underrepresented groups toward service-learning,” in Proc. ASEE Annual Conference & Exposition, Vancouver, BC, 2011.