

Addressing the Exclusion of Adult Learners from Engineering Pipelines: Mapping Transitions from Competency-Based Education to STEM Fields (Work in Progress)

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Making Returning Adult Learners Visible in Engineering Education Pathways: A Work-in-Progress Study of Competency-Based Adult Education

Abstract

The purpose of this work-in-progress research paper is to examine how adult learners who re-enter education through high school equivalency (HSE) pathways are positioned within engineering education and workforce pathways. Using the National External Diploma Program (NEDP) as a case context, this study highlights a gap in understanding what happens after adult learners complete competency-based secondary credentials, particularly in relation to entry into Science, Technology, Engineering, and Mathematics (STEM) and engineering pathways.

Drawing on national NEDP data, this paper examines what is currently known about graduates earning an HSE and their trajectories following completion of this competency-based diploma program. While many graduates report intentions to continue their education or training, existing data do not capture whether they actually enroll, persist, or enter specific fields such as STEM or engineering. Without this information, traditional, uninterrupted pathways continue to be treated as the primary route into engineering, while adult re-entry pathways remain largely overlooked in research and policy, especially for those with an HSE.

To address these limitations, the study introduces an IRB-approved follow-up graduate survey designed to capture postsecondary participation, workforce alignment, perceived preparedness, and structural barriers related to STEM and engineering pathways that are not visible in existing administrative datasets.

Grounded in principles of adult learning and competency-based education, this work frames measurement as a way to better understand and make visible the pathways returning adult learners take after completing secondary credentials. By capturing these pathways, the study aims to inform program improvement and expand how entry into engineering is defined. Implications for adult education practice and pathway design are discussed, with the goal of strengthening institutional support for returning adult learners with an HSE pursuing technical and engineering futures.

This work invites discussion on how data and measurement practices influence which learners are represented in engineering education research and how expanding these practices can better support returning adult learners' pathways.

1. Introduction

Approximately 41 million adults in the United States aged 25 and older do not hold a high school diploma or equivalent, highlighting a substantial population that may benefit from re-entry pathways into education [1]. Adult secondary completion pathways provide a mechanism for learners to return to education after significant interruptions in formal schooling, yet these pathways remain largely overlooked as entry points into postsecondary education, including STEM, engineering, and technical fields [2], [3].

Prior research on adult learners in engineering has primarily focused on individuals who are already enrolled in postsecondary engineering programs, examining their learning approaches, motivations, and experiences within higher education settings [3], [4], [5]. While this work provides valuable insight into adult learning once learners have entered engineering pathways, it does not address how adults who complete alternative or competency-based secondary credentials navigate entry into STEM or engineering programs in the first place [3], [4]. Consequently, little is known about whether adult diploma pathways function as potential on-ramps into engineering education or how adult learners perceive their readiness for such programs prior to enrollment.

The National External Diploma Program (NEDP) functions as a competency-based high school equivalency pathway designed for adults (18+) seeking to resume interrupted educational trajectories [7]. Unlike high school equivalency exams that rely on standardized testing, NEDP requires participants to demonstrate mastery of secondary-level competencies through applied performance tasks situated in life and work contexts. The program is delivered remotely and emphasizes digital literacy, self-directed learning, and real-world problem solving, features that may shape graduates' readiness for postsecondary and technical environments [7], [8].

Existing program data indicate that a substantial majority of NEDP participants, nearly 70%, report intentions to pursue further education or training following diploma completion [9]. However, national NEDP data primarily capture short-term, self-reported outcomes and do not systematically track long-term educational pathways or entry into specific fields such as STEM or engineering [8], [9]. This gap limits understanding of whether graduates enroll, persist, or enter technical and engineering-related pathways, contributing to the continued underrepresentation of returning adult learners in engineering education research [2], [3]. While many returning adult learners bring relevant workforce experience, they may still face limited exposure to engineering pathways, and misalignment in program design may restrict access to these fields [2], [3].

This work-in-progress paper examines adults who complete the NEDP as a case context for understanding these transitions. Using existing national NEDP graduate outcome data, the paper documents what is currently known about graduates' reported postsecondary pathways and introduces an IRB-approved follow-up survey designed to capture longer-term postsecondary completion, workforce participation, and graduates' perceptions of preparedness and exposure to STEM and engineering pathways.

This gap is particularly important given the transition of the NEDP program to a fully online model in 2013. Since transitioning from paper-based to fully online delivery, the program now requires sustained engagement with digital tools and problem-solving environments that are increasingly relevant for postsecondary success. However, existing data do not examine whether this shift influences graduates' readiness for or engagement with STEM and engineering pathways, further highlighting the need for systematic follow-up measurement.

2. Defining the Adult Education Learner

This study focuses on learners with interrupted academic pathways, defined as individuals who experienced a pause in formal secondary education and later re-entered with explicit academic and career goals. Although many studies define adult learners as those twenty-five and older, the NEDP supports individuals eighteen and above who have faced obstacles preventing timely secondary completion [3], [4]. This definition aligns with adult education research emphasizing interruption, re-entry, and goal-directed participation rather than age alone [5], [6]. Learners with interrupted academic pathways differ from traditionally aged students who progress directly from high school to college.

For many learners with interrupted academic pathways, returning to education represents a strategic decision aimed at improving employment prospects, accessing postsecondary education, or qualifying for advancement in technical or professional fields [8], [9]. However, because their educational trajectories do not align with conventional timelines, their postsecondary transitions are often difficult to capture in existing datasets. Within engineering education research, adult learners are most frequently studied only after enrollment in engineering programs, leaving earlier transition points largely unexplored [2], [3], [4].

3. The National External Diploma Program (NEDP)

The National External Diploma Program (NEDP) is a nationally recognized, competency-based high school diploma program designed for adult learners age 18 and older [7]. Unlike standardized high school equivalency exams, NEDP assesses secondary-level academic and workforce readiness through performance-based demonstrations situated in life and work contexts. Participants complete competencies aligned with secondary-level expectations in applied mathematics, reading, writing, problem solving, and technology use [7], [8].

NEDP emphasizes mastery rather than seat time, requiring learners to demonstrate competence through applied, contextually situated tasks rather than time-based coursework. This mastery-based structure reflects core principles of andragogy, including self-direction, relevance to lived experience, and intrinsic motivation, which are particularly salient for learners re-entering education with explicit workforce or postsecondary goals [6]. These features align with competencies increasingly valued in postsecondary education and technical fields. However, while NEDP assesses applied academic and digital skills, it does not explicitly track whether graduates pursue STEM or engineering pathways following diploma completion.

4. What Existing NEDP Data Show

National NEDP outcome data provide insight into graduates' immediate postsecondary transition plans. Data from the NEDP Graduate Follow-Up Survey (CASAS, 2021; n = 1,719) and the 2024–2025 Yearly Statistical Report indicate that NEDP participants are predominantly women (71%), with 55% identifying as Black or African American, American Indian or Alaska Native, or as two or more races [8], [9]. Among survey respondents, community college was the most frequently reported postsecondary destination (60.2%), followed by certificate programs (25.8%), four-year colleges (17.5%), and apprenticeship pathways (9.4%). These demographic patterns underscore the importance of examining adult diploma pathways as structurally distinct

entry points into postsecondary education, rather than attributing outcomes to individual learner characteristics.

Graduates commonly reported gains in applied mathematics and numeracy, as well as consumer awareness and financial literacy, as key outcomes of program participation [8]. While these data demonstrate continued postsecondary participation, they do not capture whether graduates enroll in STEM or engineering programs, complete postsecondary credentials, or enter technical or engineering-related occupations. Nor do existing datasets assess whether graduates felt prepared for STEM coursework or introduced to engineering career pathways.

5. The Need for Follow-Up Measurement

In engineering education research, what is measured shapes which populations and pathways are recognized in policy and program conversations. When adult secondary pathways are not tracked, these learners remain largely absent from engineering narratives, reinforcing uninterrupted progression as the primary route into engineering. By disaggregating adult graduates' postsecondary pathways, preparedness, and perceived barriers, this study uses measurement to better understand and make visible these transitions. Expanding measurement can help inform program and policy decisions and support broader recognition of adult re-entry pathways within engineering education and the workforce.

Engineering education research has largely focused on traditionally aged students already enrolled in engineering programs, offering limited insight into earlier pathway entry points for adult learners [2], [3], [4]. As a result, the absence of STEM- and engineering-specific outcome data for adult diploma graduates represents a critical measurement gap. Without information on postsecondary completion, field of study, workforce outcomes, and perceived preparedness, it is not possible to assess whether competency-based adult diploma programs function as potential on-ramps into engineering and technical fields.

The existing NEDP Graduate Follow-Up Survey captures graduates' immediate post-completion plans and short-term outcomes. While valuable for understanding initial transitions, this instrument does not disaggregate pathways by field of study, workforce alignment, or perceived preparedness for STEM and engineering participation.

To address this gap, this study introduces an IRB-approved, cross-sectional retrospective survey administered to NEDP graduates from 2013–2025. Unlike the immediate post-completion survey, this second instrument captures longer-term educational and workforce trajectories as well as graduates' reflections on preparedness and structural barriers related to STEM and engineering pathways. With many educational and workforce transitions occurring years after diploma completion, a retrospective cross-sectional design allows graduates to report outcomes not captured in short-term administrative follow-up reporting.

Consistent with its work-in-progress status, this paper does not report finalized survey findings. Instead, it establishes the empirical and theoretical rationale for follow-up measurement and situates the survey as a necessary step for making adult learners' engineering and STEM pathways visible within engineering education research.

6. Survey Design and Measures (Work-in-Progress)

To address the limitations identified in existing NEDP administrative datasets, this study introduces an IRB-approved, cross-sectional retrospective survey administered to NEDP graduates from 2013–2025. The survey is designed to capture postsecondary education, workforce participation, and perceived preparedness for STEM, engineering, and technical pathways—outcomes that are not currently visible in national NEDP reporting mechanisms.

The survey employs a branching structure to differentiate between graduates who pursued postsecondary education, training, or new employment following NEDP completion and those who did not. This design enables parallel examination of both realized and aspirational pathways, acknowledging that the absence of postsecondary enrollment does not necessarily indicate lack of interest or readiness. All respondents complete a core set of background questions, while subsequent sections adapt based on post-NEDP pathway engagement.

Preparedness items assess perceived readiness for postsecondary coursework and technical or engineering-related work. These items use five-point Likert-type scales (1 = Not at all prepared to 5 = Very prepared). Example items include: “How prepared did you feel to apply mathematics in your college program or job?” and “How prepared did you feel to use digital tools required for coursework or employment?” These measures align with NEDP’s competency-based assessment of applied mathematics, technology use, and self-directed task completion, allowing examination of whether program-aligned competencies translate into perceived readiness for STEM and engineering participation.

Barrier-related items measure structural and psychosocial factors that may influence participation in postsecondary education or technical fields. Using agreement scales (Strongly disagree to Strongly agree), items include: “Financial responsibilities made continuing education difficult,” “Lack of time due to work or family limited my participation,” and “I did not feel confident in my math or technical skills when considering STEM-related programs.” These measures allow differentiation between lack of interest and structural constraints, consistent with adult education literature emphasizing external responsibilities and role conflict among returning adult learners [5].

Additional items assess learners’ confidence in acquiring technical skills and the perceived usefulness of continued education or employment. Example items include: “I am confident in my ability to learn new technical skills” and “Continuing education helps me reach my long-term goals.” These items examine motivational dimensions that may shape adult entry into engineering pathways, without assuming traditional postsecondary trajectories.

Survey items are organized across six primary domains: (1) demographic and background characteristics; (2) postsecondary education, training, and workforce pathways; (3) field of study or occupational area, including STEM, technical, and skilled trades; (4) perceived preparedness for postsecondary coursework and work-related tasks, including digital skills, applied mathematics, and self-management; (5) barriers to participation and persistence, including financial, technological, and psychosocial factors; and (6) confidence, perceived value, and sense

of belonging related to continued education and technical fields. An open-ended item invites graduates to describe supports needed for entry or success in technical and STEM careers.

Consistent with the work-in-progress nature of this study, this paper does not report survey findings. Instead, the survey is presented as a measurement framework designed to make adult learners' STEM and engineering pathways visible within engineering education research. Future phases of this work will integrate survey responses with administrative NEDP data to examine how NEDP's competency-based design can be refined to build on existing strengths and address areas where additional supports may enhance learners' preparation for postsecondary STEM, engineering, and technical pathways. This study also seeks to make visible a population that remains underexamined in engineering education research by distinguishing returning adult learners based on educational interruption and andragogical learning needs, rather than chronological age alone [2], [4], [5], [6].

Making adult learners' postsecondary STEM and engineering trajectories visible is a necessary precursor to examining whether engineering education structures align with the realities of educational interruption, employment responsibilities, and self-directed learning that characterize returning adult learners. While this work-in-progress focuses on measurement and pathway visibility, future research will investigate how engineering programs can respond to these findings through flexible pacing, scaffolded mathematics pathways, and instructional practices informed by andragogical principles. Visibility, in this sense, functions as the first step toward structural consideration rather than the final goal.

This study was conducted in collaboration with a nationally recognized adult secondary education program. Aggregated administrative data were used, and survey administration was approved through an Institutional Review Board (IRB) at a large public research university. These findings suggest a need for engineering and STEM programs to better align with the experiences, responsibilities, and principles of adult learning that shape how returning learners engage with education.

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