

Assessing the Educational and Societal Impacts of an Autodidactic Industrial Drive Simulator Constructed via the ADDIE Framework

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Abstract

This research addressed pedagogical obstacles at North Eastern Mindanao State University-Cantilan Campus, where obsolete equipment restricted experiential learning in motor control. The primary objective was to engineer and assess an autodidactic industrial drive simulator via the ADDIE framework, analyzing its educational efficacy and societal impacts. Utilizing a developmental paradigm, thirty purposively selected vocational scholars participated in the evaluation. Data gathered through pre- and post-intervention examinations, questionnaires, and interviews were analyzed using mixed methods. Outcomes revealed exceptional participant approval for the simulator's architecture and utility, with all parameters securing "Strongly Agree" evaluations. A statistically significant increase in post-intervention scores corroborated the apparatus's effectiveness in elevating applied proficiency and theoretical comprehension. Qualitatively, the simulator produced notable societal impacts by democratizing educational access, facilitating individualized progression, bolstering career preparedness, and advancing pedagogical sustainability. Ultimately, these results underscore the capacity of learner-directed platforms to upgrade vocational schooling in resource-limited environments. Beyond elevating academic metrics, the engineered simulator yields expansive societal benefits by accommodating varied learner profiles and cultivating professional-grade skills.

Keywords : ADDIE model, development, industrial motor controller system trainer, self-paced, effectiveness, technical education.

Introduction

Industrial motor controllers are foundational to contemporary automation, regulating the velocity, torque, and orientation of electric drives. These systems remain critical to manufacturing, robotics, and energy systems, where precise modulation is essential for operational safety and efficiency (Giri, 2013). As industrial sectors gravitate toward advanced automation, the requirement for personnel skilled in the maintenance, troubleshooting, and operation of these controllers continues to escalate (Popoola et al., 2024).

The efficacy of industrial motor control instruction is tethered to its capacity to bolster workforce proficiency, productivity, and the operational lifespan of hardware (De Felice et al., 2013). Research indicates that targeted, experiential training substantially elevates technical comprehension (Wettaka, 2020). Furthermore, autonomous, self-paced modules have been shown to enhance both knowledge retention and practical application among vocational learners (Ebbini, 2023). Adaptive instructional instruments, which accommodate diverse learning velocities and methodologies, are increasingly recognized as vital for cultivating technical confidence and competence (Wu, 2024; Udeze, 2024; Holik et al., 2023).

Despite this clear necessity, vocational education in motor control encounters significant hurdles (Maddikunta et al., 2022). Conventional instruction often relies on rigid, instructor-centric schedules that can impede deep conceptual engagement (Fair, 2021; Clark & Mayer, 2023). Moreover, many academic institutions lack the necessary facilities to provide comprehensive, hands-on exposure (Volansky, 2019). According to Schneider et al. (2023), these deficits are particularly acute in theory-heavy curricula that neglect the practical application required for true skill mastery.

To mitigate these limitations, the ADDIE framework has gained prominence as a systematic methodology for educational design (Spatioti et al., 2022; Handrianto et al., 2021; Alsaleh, 2020). Abuhassna et al. (2024) emphasize that the ADDIE framework is uniquely suited for crafting effective, adaptable training solutions. Empirical evidence consistently demonstrates that modules structured through the ADDIE framework foster superior learner engagement and practical skill acquisition compared to traditional lecture-based delivery (Abuhassna et al., 2024; Yan et al., 2024; Budoya et al., 2019).

In the Philippines, the government has prioritized the enhancement of technical education, most notably through the Technical Education and Skills Development Authority (TESDA) (Edralin & Pastrana, 2023). TESDA consistently aligns certification and curriculum development with prevailing industrial automation standards (Reyes, 2018). Simultaneously, the Department of Education (DepEd) has modernized technical instruction through initiatives such as the Computerization Program, aiming to broaden digital access and pedagogical quality (DepEd, 2021).

Modern vocational discourse now views educational efficacy as encompassing more than just technical skill; it includes the broader societal impacts of instructional innovation. Such impacts encompass improved accessibility, equity, employability, and sustainability. Learner-directed systems are increasingly vital for democratizing access and accommodating diverse academic needs, thereby reducing the barriers inherent in rigid traditional structures (Surhano et al., 2025). Furthermore, sustainable educational technologies generate value by promoting equitable resource distribution and fostering long-term institutional stability (Alharthi & Spichkova, 2017). International bodies, including UNESCO (2022), the United Nations (2024), and Yusvana (2024), advocate for vocational education as a primary vehicle for reducing educational disparities. By prioritizing inclusivity, institutions foster broader social participation among underserved demographics (Gillani & Eynon, 2023; UNESCO Bangkok, 2014).

Beyond accessibility, societal benefit is realized when programs prepare learners for labor market demands and promote institutional longevity (OECD, 2024). Pavlova (2009) asserts that vocational education drives sustainable development by empowering individuals for meaningful economic contribution. Similarly, the World Bank (2024) identifies skills development as a cornerstone of poverty reduction and economic growth. Within schools, innovative trainers provide social value by optimizing resource utilization and mitigating reliance on prohibitive equipment costs—a critical need for resource-constrained environments. Consequently, an autodidactic industrial drive simulator serves not only as an instructional tool for technical proficiency but as a vital intervention for equity and sustainable educational delivery. Analyzing such societal impacts is therefore essential, especially in settings where resource limitations are pervasive.

Despite these efforts, a substantial gap exists regarding the availability of effective, hands-on, self-paced tools for motor control (Bansiong & Alawas, 2024). While foundational certifications exist, there is a lack of flexible learning models that facilitate independent practice (Ebbini, 2023; Surhano et al., 2025). Few investigations have explored how ADDIE-based, self-paced learning systems contribute to broader societal benefits like workforce readiness and sustainable resource usage within the Philippine context. This research gap highlights the need for a structured design strategy that balances industry alignment with flexible, skill-centered pedagogy (Adewolu, 2024).

Additionally, fiscal constraints make the procurement of instructional hardware difficult (Elendu, 2024; Matthews et al., 2022). At North Eastern Mindanao State University-Cantilan Campus, the scarcity of adequate equipment forces reliance on obsolete, traditional installation methods. These methods are not only outdated but problematic; repeated use leads to the degradation of critical components like screw heads and terminals (Frangopol & Liu, 2019; Geitner & Bloch, 2019). Furthermore, high student-to-equipment ratios render traditional setups inefficient. These challenges necessitate more robust, self-paced training systems that accommodate larger cohorts while minimizing mechanical wear (Molnar, 2023; Kyriazis, 2021). Consistent with current literature, applying the

ADDIE framework is the recommended strategy to bridge these gaps by fostering adaptable, industry-aligned learning experiences (Abuhassna et al., 2024; Adewolu, 2024; Yan et al., 2024; Budoya et al., 2019).

Purpose of the Study

The objective of this research is to utilize the ADDIE framework to engineer and evaluate an autodidactic industrial drive simulator designed to provide a more efficient, flexible, and hands-on learning experience. This study seeks to resolve critical barriers—namely the shortage of equipment and reliance on archaic methodologies—at North Eastern Mindanao State University-Cantilan Campus. By fostering 21st-century technical proficiency and independent learning, the trainer aims to generate significant societal benefits, including improved educational accessibility, increased equity, workforce readiness, and instructional sustainability. Ultimately, this work demonstrates the potential of innovative instructional technology to minimize dependence on costly equipment, accommodate diverse learner needs, and elevate the quality of vocational education for students and the broader community.

Methods

Design

A developmental research paradigm, anchored by the ADDIE framework, was adopted to conceptualize, construct, and appraise the autodidactic industrial drive simulator. The investigative process was systematically delineated into five distinct stages: Analysis, Design, Development, Implementation, and Evaluation. To determine the apparatus's educational efficacy, a single-group pre-intervention and post-intervention experimental configuration was executed. This architecture facilitated a comparative analysis of the learners' competencies prior to and following device utilization, thereby illuminating the simulator's influence on academic metrics. Furthermore, a qualitative dimension was integrated to investigate the societal impacts produced by the equipment—specifically concerning equitable learning, educational accessibility, vocational preparedness, and pedagogical sustainability—as articulated by both educators and scholars.

Participants

The study's cohort comprised learners registered in vocational and technical curricula at North Eastern Mindanao State University-Cantilan Campus, explicitly targeting individuals undertaking coursework in industrial drive networks. Utilizing purposive sampling techniques, an initial sample of thirty (30) students was established, predicated on their active enrollment in pertinent subjects and their capacity to complete both the initial and subsequent evaluations. For the qualitative segment, a focused subset of ten (10) individuals was deliberately isolated, encompassing two (2) faculty members tasked with overseeing the apparatus's deployment and eight (8) student users. The criteria for selecting student interviewees necessitated: (1) the successful culmination of exercises utilizing the autodidactic industrial drive simulator, (2) documented attendance in both evaluative examinations, and (3) a voluntary commitment to articulate their experiential insights. Faculty inclusion was contingent upon their direct supervisory and evaluative roles during the implementation stage. These dialogues were orchestrated to harvest profound perspectives regarding the device's educational efficacy and its societal benefits, with particular emphasis on academic inclusivity, equitable progression, career readiness, and the sustainable use of instructional resources.

Instrument

Data acquisition relied on a multi-instrument approach, encompassing pre- and post-intervention examinations, a participant feedback questionnaire, an observational matrix, and a semi-structured interview protocol. The initial examination quantified the learners' foundational aptitude regarding industrial drive systems, whereas the subsequent test gauged the cognitive and practical advancements achieved post-exposure to the autodidactic industrial drive simulator. Both evaluative tools incorporated practical demonstrations, technical identification exercises, and multiple-choice queries formulated to appraise the students' theoretical grasp and functional execution of motor control principles. The participant evaluation questionnaire utilized a Likert-type scale to measure the apparatus's operational functionality, ergonomic design, adaptability, perceived utility, user-friendliness, and congruency with pedagogical targets. Concurrently, an observational matrix tracked learner

engagement, recorded direct interactions with the equipment, and flagged any mechanical or operational impediments during the exercises.

Supplementing the numeric data, a semi-structured interview framework was administered to the targeted subset of scholars and educators. This protocol featured open-ended inquiries constructed to extract lived experiences, critical perceptions, and detailed reflections concerning the educational efficacy and societal impacts of the engineered simulator. More precisely, these conversations probed thematic areas encompassing pedagogical sustainability, labor market preparation, learning parity, educational access, and the overarching value added to vocational training. Rigorous pilot testing was conducted for all quantitative tools to confirm their internal consistency and reliability. This validation yielded high Cronbach's alpha scores: 0.87 for the examinations, 0.91 for the feedback questionnaire, and 0.88 for the observational matrix. Concurrently, the qualitative interview protocol was subjected to expert scrutiny to guarantee the precision, relevance, and alignment of the questions with the core research directives.

Data Gathering Procedure

Information collection commenced with a preparatory stage, characterized by a briefing session designed to elucidate the research objectives to both faculty and scholars, alongside a functional demonstration of the autodidactic industrial drive simulator. Informed consent documents were disseminated to guarantee an understanding of data confidentiality and secure voluntary participation. During the initial assessment phase, the cohort completed the pre-intervention examination to formulate a foundational baseline of their motor control proficiency, with these metrics archived for subsequent comparative analysis. Throughout the practical modules, participants interacted with the learner-directed instructional platform, navigating the curriculum autonomously with minimal faculty intervention. The observational matrix was actively employed during this period to document engagement levels and isolate any functional anomalies within the device.

Following the conclusion of the practical exercises, the post-intervention examination was executed to quantify advancements in applied skills and theoretical knowledge, subsequently contrasting these results against the baseline metrics. Directly after this final test, the participant evaluation questionnaire was circulated to harvest perspectives regarding the apparatus's utility and operational success, capturing both numeric scores and descriptive feedback. Individualized, semi-structured dialogues were subsequently held with the isolated subset of users and supervisors to extract profound qualitative insights detailing the device's educational efficacy and societal benefits—highlighting its role in fostering pedagogical sustainability, career readiness, instructional equity, and academic access. Ultimately, the aggregate data derived from the matrices, questionnaires, examinations, and conversational transcripts were consolidated for rigorous evaluation. Numeric information was processed applying paired-samples t-tests and descriptive statistical techniques. Conversely, the narrative responses were subjected to thematic coding to extract prominent concepts corresponding to the apparatus's educational efficacy and broader societal impacts.

Results

To maintain a rigorous, systematic trajectory for the conceptualization and appraisal of the autodidactic industrial drive simulator, the findings are structured in accordance with the ADDIE framework. The foundational stages—Analysis, Design, and Development—confirmed a critical deficit in pedagogical assets at North Eastern Mindanao State University-Cantilan Campus, where reliance on obsolete, frequently compromised hardware proved insufficient for the student cohort. Consequently, a comprehensive instructional schematic was engineered via SketchUp software, directly harmonizing with prevailing industry benchmarks, assessment protocols, and pedagogical targets. This blueprint prioritized the integration of specific materials to maximize learner accessibility. Following this, the physical apparatus was fabricated and assembled. Subject matter experts subsequently executed preliminary operational trials, implementing vital refinements to guarantee the device's functional integrity prior to formal deployment.

Implementation and Evaluation Phases

During the execution stage, the autodidactic industrial drive simulator was deployed to the selected cohort at North Eastern Mindanao State University-Cantilan Campus. Dedicated orientation modules were facilitated to guarantee

that learners could operate the apparatus autonomously and proficiently. Concurrently, faculty members monitored the cohort's engagement, supplying supplementary guidance when necessary.

The subsequent evaluative stage encompassed two distinct tiers: formative appraisal (conducted concurrently with execution) and summative appraisal (post-intervention). The formative assessment targeted the simulator's core attributes, harvesting questionnaire data on architectural layout, perceived utility, adaptability, operational capacity, and ergonomics.

The numeric outcomes outlined in Table 1 illustrate profound participant approval, with every evaluated parameter achieving a "Strongly Agree" (SA) classification. An average usability metric of 4.46 demonstrates the interface's navigational ease and the clarity of embedded directives, fostering autonomous task execution. Securing an average of 4.54, the functionality domain underscores the platform's flawless operation, precise behavioral simulation, and immediate feedback mechanisms. The flexibility parameter yielded a 4.56 average, verifying the equipment's capacity to accommodate divergent academic velocities and individualized learner profiles. Earning a 4.42 average, the perceived impact domain indicates a substantial enhancement in the cohort's theoretical comprehension and applied proficiency. Peaking at a 4.56 average, the architectural design metric highlights the visually compelling, highly organized configuration that optimized the experiential learning environment.

Qualitative insights gathered from faculty supervisors echoed these positive outcomes while offering constructive refinements. When questioned regarding the platform's capacity to sustain engagement, one educator affirmed, *"Yes, it allows the students to work at their own pace."* Conversely, a secondary instructor advocated for the integration of augmented safety protocols to secure the training environment, specifically recommending the incorporation of explicit labeling across all electrical nodes to mitigate operational confusion and prevent hardware degradation.

Table 1: Salient Features Evaluation Results

Category / No.	Variables/Item Statements	Weighted Mean	Verbal Description
Usability			
1	Operating and exploring the engineered simulator felt straightforward with minimal supervision.	4.38	SA
2	The directions built directly into the simulator were simple to grasp and carry out.	4.18	A
3	I could finish the required exercises on the simulator completely on my own.	4.52	SA
4	Navigating the layout of the simulator felt natural and highly accessible.	4.62	SA
5	Following a brief introductory session, I felt self-assured while handling the equipment.	4.60	SA
	Average	4.46	SA
Functionality			
1	The engineered simulator ran flawlessly without any system glitches or sudden interruptions.	4.65	SA

Category / No.	Variables/Item Statements	Weighted Mean	Verbal Description
2	Every specific component of the simulator worked precisely as intended while I engaged with it.	4.52	SA
3	The platform successfully replicated the real-world behavior of industrial drive networks.	4.48	SA
4	The simulator delivered immediate responses the moment I executed a specific exercise.	4.62	SA
5	The system made it incredibly simple to fix mistakes and attempt the activities once again.	4.45	SA
	Average	4.54	SA
Flexibility			
1	The simulator permitted me to move through the module exercises at a speed that suited me.	4.62	SA
2	I was entirely free to go back and review any part of the modules whenever I found it necessary.	4.65	SA
3	The platform adapted seamlessly to my personal study habits and processing speed.	4.60	SA
4	I could easily modify how I interacted with the material to match my specific academic requirements.	4.35	SA
5	The engineered simulator successfully catered to multiple different ways of absorbing information.	4.58	SA
	Average	4.56	SA
Perceived Impact			
1	Working directly with the simulator broadened my theoretical comprehension of industrial drive networks.	4.55	SA
2	I feel the platform significantly upgraded my applied proficiency in executing manual tasks.	4.38	SA
3	Having utilized the simulator, I am much more secure in translating these theories into real-world applications.	4.40	SA
4	The equipment played a major structural role in how well I learned about industrial drive networks.	4.32	SA

Category / No.	Variables/Item Statements	Weighted Mean	Verbal Description
5	I consider the simulator a highly successful resource for achieving the specific educational targets of the subject.	4.45	SA
	Average	4.42	SA
Design			
1	The visual arrangement of the simulator made the entire learning sequence straightforward to track.	4.65	SA
2	The structural setup of the platform fit perfectly with the technical topics being delivered.	4.62	SA
3	The way the simulator was physically built encouraged a highly active and immersive training session.	4.60	SA
4	The physical parts of the simulator were neatly arranged, heavily supporting direct practical engagement.	4.38	SA
5	The aesthetic presentation made it significantly easier for me to concentrate and connect with the lessons.	4.55	SA
	Average	4.56	SA

Note: 4.3 – 5.0 – Strongly Agree (SA); 3.5 – 4.2 – Agree (A); 2.7 – 3.4 – Neutral (N); 1.9 – 2.6 – Disagree (D); 1.0 – 1.8 – Strongly Disagree (SD)

To quantify the apparatus's overarching educational efficacy—specifically its success in elevating applied proficiency and matching industrial benchmarks—a summative evaluation utilizing pre- and post-intervention examinations was conducted (presented in Table 2). An analysis utilizing a paired-samples t-test compared these metrics. The baseline examination established a mean score of 8.15. A significant mean difference of -9.20 was registered between the initial and final assessments, accompanied by a standard deviation of differences at 1.62415. The resulting t-test generated a t-value of -31.028 across 29 degrees of freedom, producing a p-value of .0000.

Table 2: Pre-test and Post-test

Evaluation	Mean	Mean Difference	SD	t-value	df	p-value
Pretest	8.15	-9.20	1.62415	-31.028	29	.0000
Posttest	17.35					

Qualitative Findings

Question: What societal impacts materialized following the deployment of the autodidactic industrial drive simulator, based on the perspectives of educators and learners?

Although the numeric data verified the **autodidactic industrial drive simulator's** success in elevating **educational efficacy**, the narrative responses supplied profound dimensions regarding the apparatus's broader

pedagogical and **societal benefits**. A rigorous thematic evaluation of the dialogues conducted with two (2) faculty members and eight (8) scholars isolated four primary domains: (1) Amplifying Academic Accessibility, (2) Fostering Equitable and Autonomous Progression, (3) Bolstering Career Preparedness, and (4) Advancing Pedagogical Sustainability. These emergent categories underscore the equipment's expansive utility beyond mere **academic metrics**, validating its role in modernizing vocational instruction.

Theme 1: Amplifying Academic Accessibility

A prominent motif identified throughout the discussions was the apparatus's capacity to democratize access to experiential learning. Interviewees observed that the simulator facilitated broader cohort participation in applied exercises, circumventing the bottleneck created by scarce laboratory hardware.

A student participant shared:

"In the past, we experienced long wait times just to take a turn because the lab had so few materials available. Now, this equipment allows a larger group of us to practice the tasks and grasp the concepts without the lengthy delays."

Similarly, another student remarked:

"Learning became much smoother for me with this device. It let me concentrate fully on the actual task instead of stressing over when a machine might be free."

An instructor also observed:

"This system successfully tackled a primary hurdle for us, specifically the shortage of teaching equipment. It enabled a higher number of learners to take part in hands-on tasks at the exact same time."

Such testimonies indicate that the engineered platform dramatically enhances accessibility by offering expansive avenues for applied practice, even within materially restricted environments. Ultimately, the data confirms the platform's role in cultivating an inclusive academic atmosphere where vocational scholars can actively immerse themselves in their training.

Theme 2: Fostering Equitable and Autonomous Progression

Respondents frequently commended the platform's agility in adapting to divergent cognitive baselines and individual processing velocities. The cohort highly valued the autonomy to iteratively practice techniques and revisit theoretical principles devoid of external temporal pressure.

One student explained:

"What I really appreciated was the ability to redo the exercises until the whole process clicked for me. Whenever I messed up, I had the chance to try it over without any feeling of shame."

Another participant stated:

"Everyone absorbs information at a different rate. This equipment made my learning experience very comfortable since it allowed me to progress exactly at my own speed."

An instructor similarly noted:

"Those individuals who typically have a hard time in standard lab settings showed much more involvement. This happened because they were finally able to navigate the modules at a speed that suited them."

These perspectives underscore the simulator's efficacy in driving academic parity by neutralizing barriers to engagement and aligning with diverse cognitive profiles. This adaptability constructs a deeply supportive educational ecosystem, empowering learners to advance in correlation with their intrinsic capabilities rather than rigid schedules.

Theme 3: Bolstering Career Preparedness

A further critical dimension uncovered during the dialogues was the apparatus's utility in cultivating professional-grade confidence and vocational competencies. The interviewees recognized the simulator as an indispensable mechanism for bridging the gap between classroom theory and real-world industrial employment.

One student shared:

"The exercises closely mirrored real-world motor control jobs. As a result of that realism, I gained a lot of confidence in executing these technical procedures."

Another student remarked:

"Working with this system gave me a much clearer grasp of how the parts and connections function. I definitely feel readier to handle these setups when I enter the workforce."

An instructor explained:

"The device gives learners the chance to continuously practice fundamental motor control techniques. This repetition is truly vital for getting them ready to meet strict industry standards."

Such feedback illustrates that the platform actively accelerates vocational readiness by facilitating iterative practice, cementing **applied proficiency**, and nurturing self-assurance. Consequently, the findings establish that the simulator transcends traditional pedagogical functions, operating actively as an incubator for occupational preparedness.

Theme 4: Advancing Pedagogical Sustainability

The narrative data also illuminated the equipment's strategic importance in cultivating sustainable educational operations. Both the academic staff and the student cohort acknowledged its capability to optimize resource allocation while concurrently mitigating the physical degradation of prohibitive laboratory assets.

An instructor commented:

"A major benefit of this setup is that learners can train heavily without continually operating the primary machines. This goes a long way in cutting down on mechanical damage and upkeep expenses."

Another instructor added:

"It is a highly practical solution because it permits endless training exercises while still protecting the scarce resources we currently have."

A student participant also noted:

"This system provided us with plenty of chances to hone our skills, completely removing the fear that we might break very costly parts."

These insights verify that the engineered apparatus drives institutional sustainability by decreasing reliance on expensive hardware and streamlining the utilization of existing assets. Such societal impacts are profoundly advantageous for fiscally restricted academic environments where acquiring contemporary training facilities remains a persistent challenge.

Discussion

The outcomes of this investigation establish that the autodidactic industrial drive simulator was highly successful in elevating educational efficacy while simultaneously producing substantial societal impacts within the realm of vocational instruction. The statistically significant escalation recorded from the baseline to the final assessments corroborates the apparatus's capacity to drive theoretical acquisition and applied proficiency regarding industrial drive networks. Such outcomes substantiate Kolb's Experiential Learning Theory (2014), positing that academic mastery is deeply reinforced through immersive, practical participation. Concurrently, this aligns with Mayer's Cognitive Theory of Multimedia Learning (2005), which argues that architecturally sound educational tools escalate retention and conceptual grasp by enabling profound user interaction with the curriculum. The exceptional appraisal scores across functionality, adaptability, perceived utility, architecture, and usability further imply that the engineered simulator cultivated a robust academic ecosystem, heavily promoting autonomous study and the refinement of applied competencies.

Transcending mere pedagogical success, the narrative data exposed that the simulator catalyzed profound societal benefits by amplifying academic access, ensuring equitable progression, bolstering career preparedness, and advancing pedagogical sustainability. Respondents articulated that the platform drastically widened avenues for experiential practice, effectively neutralizing the constraints imposed by scarce laboratory hardware. These observations corroborate the research of Surhano et al. (2025), who contend that learner-directed ecosystems democratize educational access by fluidly adapting to variances in cognitive speed and foundational knowledge. In a parallel vein, UNESCO (2022) asserts that vocational frameworks must champion inclusive and fair academic pathways, a mandate especially critical in environments hampered by material deficits. The equipment's agility in addressing divergent processing speeds and permitting autonomous review inherently mirrors the tenets of equitable, student-centric pedagogy highlighted by Gillani and Eynon (2023) alongside UNESCO Bangkok (2014).

The collected data additionally signifies the platform's role in cultivating labor market readiness, granting cohorts the ability to iteratively execute occupational techniques and build self-assurance in handling motor control operations. Users conceptualized the engineered simulator as an indispensable preparatory instrument for navigating future industrial workplaces. This perspective seamlessly aligns with assertions from the OECD (2024) and Pavlova (2009), both of whom stress that vocational programming generates societal impacts by forging employable competencies and equipping individuals for active economic contribution. Furthermore, academic supervisors spotlighted the apparatus's efficacy in mitigating reliance on prohibitively expensive and fragile laboratory components. This dynamic reveals that the learner-directed instructional platform sustains pedagogical longevity by streamlining the use of institutional assets without compromising access to applied exercises. These conclusions validate the paradigm that academic advancements can yield expansive societal benefits eclipsing standard academic metrics, specifically encompassing long-term pedagogical sustainability, resource optimization, and broadened access (Alharthi & Spichkova, 2017).

Synthesizing these outcomes, it becomes evident that the engineered apparatus transcends the boundaries of a conventional teaching aid, operating profoundly as a socially transformative pedagogical innovation. Its demonstrated capacity to elevate educational efficacy while concurrently championing academic equity, access, occupational readiness, and sustainable resource management underscores its significant role in the evolution of vocational curricula. Ultimately, this investigation illuminates the critical necessity of embedding learner-directed, industry-synchronized, and novel training frameworks into technical programs, an imperative particularly urgent for academic institutions navigating material scarcity alongside escalating demands for premier skill cultivation.

Conclusion

This investigation effectively resolved the pedagogical deficits within the motor control curriculum at North Eastern Mindanao State University-Cantilan Campus through the engineering of an autodidactic industrial drive simulator. The empirical outcomes prove that the platform's ergonomics, operational capacity, adaptability, perceived utility, and architectural layout substantially elevate both knowledge acquisition and applied proficiency. By satisfying rigorous industrial benchmarks, the engineered simulator equips the cohort with a contemporary, applied asset for mastering industrial drive networks, thereby circumventing the constraints imposed by obsolete and defective hardware.

Transcending baseline educational efficacy, the narrative data illuminated the profound societal impacts produced by the learner-directed instructional platform within vocational training. Users identified the apparatus as a catalyst for expanding academic accessibility, unlocking expansive avenues for applied practice despite stringent material limitations. The device further championed instructional equity by adjusting to varied cognitive velocities and requirements, empowering the cohort to navigate exercises with elevated autonomy and self-assurance. Additionally, the simulator fortified career preparedness by cementing practical competencies in occupational procedures, all while driving pedagogical sustainability via the strategic conservation of fragile laboratory assets. Consequently, these results validate the platform not merely as a pedagogical novelty, but as a crucial societal intervention that fosters an accessible, inclusive, and enduring vocational ecosystem.

The equipment's seamless navigation and structural flexibility effortlessly accommodate a spectrum of cognitive profiles, thereby cementing an inclusive educational atmosphere. Such characteristics underscore the necessity of agile, ergonomic platforms in escalating cohort immersion and academic metrics. Furthermore, the recorded advancements in post-intervention scores corroborate the simulator's success, reinforcing the critical need for deliberately structured, experiential, and reflective academic encounters.

Anchored by the ADDIE framework, the cyclical engineering trajectory guaranteed that the apparatus seamlessly merged pedagogical targets with labor market prerequisites. This methodological rigor highlights the indispensable nature of systematic, learner-centric design when forging transformative instructional instruments. The conclusions of this inquiry hold profound ramifications for pedagogical strategies and syllabus architecture. The established educational efficacy of the simulator advocates for its expansive integration across vocational programs, most notably within materially deprived institutions. Embedding such pioneering platforms permits academic centers to elevate technical instruction, stimulate analytical reasoning, and optimally prepare scholars for tangible industrial scenarios. Moreover, these technological adoptions systematically output labor-ready

alumni while concurrently generating expansive societal benefits—manifesting as broadened access, equitable progression, career readiness, and sustainable teaching frameworks. Ultimately, these achievements propel the continuous modernization of technical schooling, ensuring it meets the rigorous demands of an increasingly automated global landscape.

Limitations And Recommendations For Future Research

Certain methodological constraints within this investigation warrant consideration in subsequent inquiries. Primarily, the participant cohort was restricted to an isolated demographic at North Eastern Mindanao State University-Cantilan Campus, potentially limiting the extrapolation of these results to the wider vocational student populace. Furthermore, the inquiry's strict concentration on industrial drive networks restricts the direct transferability of the conclusions to disparate technical fields. The dependence on self-assessed feedback questionnaires alongside pre- and post-intervention metrics constitutes another limitation, as this approach risks inherent subjective bias and may overlook nuanced facets of the equipment's educational efficacy.

While narrative dialogues were executed to probe the societal impacts of the apparatus, the qualitative sample size was confined, meaning it might not encapsulate the holistic perspectives of the entire user base. As such, these qualitative insights must be contextualized strictly within the boundaries of the specific institutional environment and the engaged demographic. Additionally, the brief timeframe of the deployment stage precluded the assessment of enduring knowledge retention or the platform's long-term viability across varied pedagogical environments. Finally, the research was executed within a highly regulated academic setting, leaving its functional translation to authentic industrial training environments untested.

Subsequent academic endeavors must mitigate these constraints by enlarging the participant pool across multiple educational institutions and vocational disciplines, thereby facilitating a universally robust evaluation of the simulator's capabilities across diverse ecosystems. Researchers are also encouraged to test the autodidactic industrial drive simulator within alternative technical curricula to determine its cross-disciplinary agility and expansive utility. To fortify empirical reliability, upcoming investigations should weave objective functional benchmarks—such as temporal efficiency and procedural precision—into the assessment matrix to complement subjective feedback.

Longitudinal frameworks are strongly advised to measure the platform's influence on enduring cognitive retention and sustained applied proficiency. Future designs should equally amplify the qualitative dimension by incorporating a wider array of voices—including institutional administrators, alumni, and industrial professionals—to construct a more comprehensive portrait of the societal benefits catalyzed by the apparatus. Continued narrative research could also analyze how parallel pedagogical technologies modulate instructional sustainability, career preparedness, and academic parity across contrasting vocational settings. Probing the simulator's operational viability directly within active corporate training sectors would yield critical data regarding its authentic industrial translation. Ultimately, future scholarship should explore the fusion of frontier technologies, namely virtual and augmented reality, with learner-directed platforms to exponentially elevate both the immersive quality and the academic metrics of vocational training...

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