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Design and Development of an Innovative Telescopic Fixed Fork Presser Machine

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Abstract

This study aimed to design, develop, and evaluate an Innovative Telescopic Fixed Fork Presser Machine (ITFFPM) for motorcycle fork alignment to address the high cost and inaccessibility of imported equipment in small workshops and training institutions. Using a developmental research design, the prototype was fabricated with key components such as a hydraulic jack, U-block arms, chuck, variable speed motor, and control system. Thirty respondents—ten instructors and twenty mechanical technology students—evaluated the ITFFPM in terms of performance, durability, safety, and design using a 5-point Likert scale. Results yielded a grand mean of 4.57, interpreted as Very Acceptable, with safety obtaining the highest mean (M = 4.74). An independent samples t-test revealed no significant difference ($p > 0.05$) between student and instructor assessments, indicating consistent evaluation. Overall, the ITFFPM proved to be a cost-effective, efficient, and pedagogically valuable innovation suitable for both instructional and industrial applications.

Keywords: Telescopic Fork; Hydraulic Press; Developmental Research; Motorcycle Alignment; Technical Education

1. Introduction

Technological innovation continues to transform industrial and educational systems by enhancing efficiency, precision, and productivity. Hydraulic pressers, which operate based on Pascal's Law, play a vital role in manufacturing and repair applications, particularly in bending, aligning, and assembling metal components (Bankar & Shinde, 2021). Chavan's (2025) work provides foundational insights into hydraulic press design and material optimization, supporting the current study's goal of developing a compact and efficient telescopic fixed fork presser machine. Despite the availability of commercial hydraulic pressers, many small workshops and training institutions face significant challenges due to their high cost and limited accessibility, particularly in developing regions.

In motorcycle servicing, the proper alignment of telescopic forks is critical for ensuring handling stability and rider safety. However, existing alignment equipment is often imported, expensive, and difficult to maintain. The development of a cost-effective, locally fabricated telescopic fixed fork presser machine addresses these limitations and supports small-scale mechanical enterprises by providing an accessible, sustainable, and functional alternative (Izogo & Ogba, 2015).

Moreover, Liu and Pásztor (2022) demonstrated through a meta-analysis of 50 studies that problem-based and hands-on instructional approaches significantly enhance students' critical thinking skills and dispositions in higher education. This pedagogical principle underpins the present study, as the innovative telescopic fixed fork presser machine serves not only as an industrial tool but also as an instructional device that promotes experiential and problem-based learning. By engaging students and technicians in practical mechanical alignment and pressing tasks, the device fosters both technical competence and critical thinking development.

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Similarly, Cardino and Namoco (2016) emphasized the importance of locally developed instructional devices in enhancing hands-on learning and usability within technical education. Locally designed equipment fosters creativity, innovation, and self-reliance among learners (Sutiani et al., 2017). Consistent with this educational framework, Baldos and Sabang (2025) developed a fault simulator for refrigeration system diagnostics, while Baldos and Chavez (2025) introduced a lighting system and air-conditioning instructional trainer—both demonstrating the educational benefits of cost-effective, locally fabricated learning technologies.

This study aims to design and develop a cost-effective telescopic fixed fork presser machine for precise motorcycle fork alignment. It seeks to construct a locally fabricated, hydraulically operated device and evaluate its functionality, usability, and instructional value based on student and technician assessments. Ultimately, the study promotes the use of innovative, locally made training equipment to enhance hands-on learning and technical competence in mechanical servicing.

2. Methodology

This study utilized a developmental research design to design, fabricate, and evaluate a functional prototype of the Innovative Telescopic Fixed Fork Presser Machine (ITFFPM) for motorcycle fork alignment. The project focused on producing a cost-effective, locally made device capable of enhancing precision and efficiency in both instructional and repair applications. The fabrication process involved constructing the machine's major components—body frame, hydraulic jack assembly, U-block arms, and electrical system—followed by a series of simulations, performance tests, and structural modifications to ensure functionality, stability, and safety.

The study involved ten (10) industrial technology instructors with over five years of teaching experience and twenty (20) mechanical technology students from the Palompon Institute of Technology (SY 2023–2024) who had completed relevant machine operation courses. Data were gathered through evaluation checklists and analyzed using the weighted mean to assess the ITFFPM's efficiency, durability, safety, and overall acceptability in terms of design and performance. Prior to the final evaluation, the prototype underwent visual inspection, dry-run testing, and necessary adjustments to guarantee proper operation. The final assessment included a demonstration and hands-on testing by participants to determine usability, performance, and instructional value.

Figure 1 illustrates the major components of the ITFFPM, namely the chuck, U-block arms, hydraulic jack, longitudinal hand wheel, tool cabinet, lead screw, dial indicator, variable speed motor, power switch, and variable speed control.

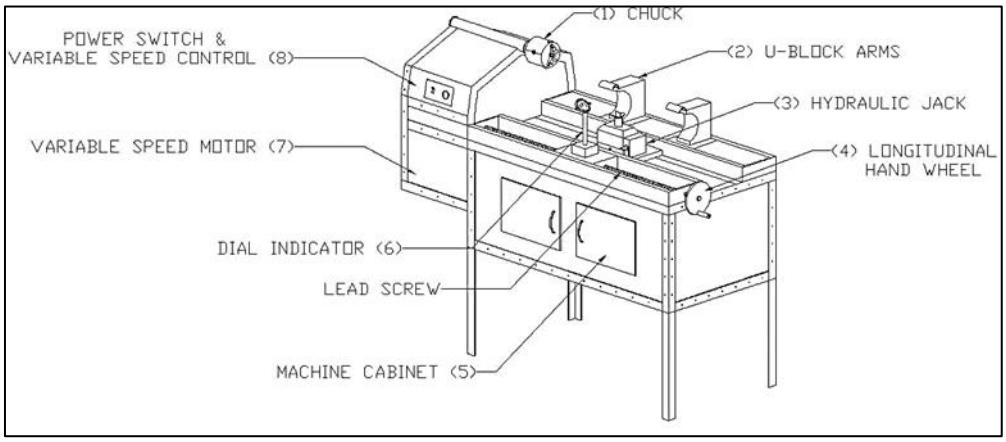

Figure 1 Innovative Telescopic Fixed Fork Presser Machine

3. Results and Discussions

The evaluation of the Innovative Telescopic Fixed Fork Presser Machine (ITFFPM) by ten (10) instructors and twenty (20) students produced consistently high ratings across all criteria. Using a 5-point Likert scale, the prototype obtained an overall grand mean of 4.57, interpreted as *Very Acceptable*. This result implies that the ITFFPM met user expectations in terms of design, performance, durability, and safety.

Among the performance indicators, the variable speed control motor attained the highest mean (M = 4.62), while the U-block arm strength under pressure recorded the lowest (M = 4.37), both within the *Excellent* range. The durability of the prototype had a mean of 4.59, indicating user satisfaction with its endurance and structural integrity. The safety aspect obtained the highest mean (M = 4.74), confirming compliance with safety standards such as secure guards, stable mountings, and proper electrical setup. The design criterion achieved a mean of 4.67, reflecting agreement among evaluators regarding the machine's functional and aesthetic quality.

To determine whether there were significant differences between the evaluations of instructors and students, an independent samples t-test was conducted. Results revealed no statistically significant difference in both performance ($t = 1.27$, $p = 0.216$) and acceptability ($t = 0.94$, $p = 0.356$). This suggests that both groups had consistent perceptions regarding the ITFFPM's efficiency and usability.

Table 1 Summary of Evaluation Results

Criteria	Students' Mean	Instructors' Mean	Average Mean	Descriptive Rating
Performance	4.90	4.40	4.51	Very Acceptable
Acceptability	4.70	4.56	4.63	Very Acceptable
Grand Mean			4.57	Very Acceptable

Table 2 Independent Samples t-test Results between Students and Instructors

Criteria	Group	N	Mean	SD	t-value	p-value	Interpretation
Performance	Students	20	4.90	0.18	1.27	0.216	Not Significant ($p > 0.05$)
	Instructors	10	4.40	0.22			
Acceptability	Students	20	4.70	0.15	0.94	0.356	Not Significant ($p > 0.05$)
	Instructors	10	4.56	0.20			

The absence of a significant difference ($p > 0.05$) confirms that both groups had a uniform assessment of the ITFFPM's quality and reliability. The low variability (CV = 5.4%) further supports the consistency of ratings. Overall, the ITFFPM was statistically verified as highly efficient, safe, and pedagogically valuable, aligning with the findings of Baldos & Sabang (2025) and Chavan (2025) who emphasized the effectiveness of locally fabricated mechanical training equipment in technical-vocational education.

4. Conclusion

The development and evaluation of the Innovative Telescopic Fixed Fork Presser Machine (ITFFPM) demonstrated that the prototype is a highly functional, durable, and safe tool for aligning and straightening motorcycle forks. Results revealed a grand mean rating of 4.57, indicating that both instructors and students found the machine *very acceptable* in terms of performance and usability. Statistical analysis using an independent samples t-test confirmed no significant difference ($p > 0.05$) between the evaluations of the two groups, signifying consistent perceptions regarding the machine's effectiveness and instructional value.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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