

Product Design of Portable Nail Puller for Practical Work

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DOI: <https://doi.org/10.30880/ritvet.2021.01.01.005>

Received 4 February 2021; Accepted 18 February 2021; Available online 31 March 2021

Abstract: Failure to pull the nail properly without damaging the material is a major problem for the user. In this regard, this study was developed to develop a portable nail pull tool that can be used to remove nails without wasting material. This study was conducted to develop a portable nail pull tool for practical training to replace existing tools manually. Through this manual action, users encounter problems when removing nails without damaging the workpiece and materials used. This product was developed using the ADDIE model as a development model. There are five phases in the ADDIE model namely the analysis, design, development, design implementation and evaluation phases. The development of this simulation uses Solidwork's designing application to develop it. Three experts have been selected to evaluate the design and functionality of the Portable Nail Puller Simulation using questionnaires and expert endorsements. Data analysis is done using percentage method. All experts agree on the development of this Nail Puller Simulation where the functionality level is 100%. Therefore, the development of these simulations can provide a clear and detailed picture to the user to develop the actual tool.

Keywords: Product design, portable nail puller, practical work

1. Introduction

The passage of time and the current global development that go hand in hand lead to innovation and creative evolution in producing sophisticated machines and equipment. This evolution is one of the major elements that play an important role in the industry to pursue higher production and productivity. The aspirations that are the essence of this industry need to be accompanied by design and ideas as the main basis for achieving convenience in completing work and adding efficient value in the use of manpower. The production of sophisticated and modern equipment has become one of the ways to fulfil the dreams of governments and countries that are now implementing more of the Industrial Revolution 4.0 (Haniffa, Mohamad, & Rambely, 2018).

A wooden hammer is an existing tool used to knock and pull nails. This wooden hammer uses the concept of a lever to remove nails. The advantage is that the force required to remove nails using a wooden hammer is less than the force of removing nails directly without a lever. The disadvantage of a wooden hammer is the damage done to the wood when using the lever method. However, the use of a wooden hammer makes it easier to remove the nails than using hands. The use of wooden hammers to remove nails is a burden because it takes a long time and a lot of energy to use. The nature of this wooden hammer makes many users unmotivated to do construction work and projects, especially the time consuming type of work.

In today's space and time, an equipment needs to be innovated to provide convenience to users in order to meet the needs of construction work (Raykar, D'Addona, & Kramar, 2014). A new equipment needs to be developed to do the work of pulling nails which is the automatic nail puller. This automatic nail puller becomes a necessity for students to ensure neatness and no damage to the wood when the nail is pulled out of the wood. This tool aims to remove the weaknesses of the wooden hammer so that there is no damage to the work. Innovation and various work products are enhanced to provide comfort of use and facilitate users during the production process of the product.

1.1 Problem Statement

The design that needs to be developed for this nail pulling product is very important in the creation of a product that can reach the standard of customer satisfaction. The question posed in this study is the issue of students pulling nails during training class. Failure to pull the nail in the right direction can damage the wood surface and nails. The use of a wooden hammer requires proper accuracy from the students who use it to avoid possible damage and save on the cost of replacing new materials (Abdullah, 2019). This also makes students less interested in doing tasks effectively, because they are not satisfied in carrying out their projects. Student safety factors must also be considered to ensure their safety while doing this practical work in the industry (Bakar, 2012). Therefore, the researcher will develop the design of a tool that can solve the problem of removing nails in the industry properly so that problems such as damage to nails, wood and workpieces can be avoided. This can indirectly allow students to complete their work without any difficulty in practice and can improve the quality of the products they produce.

1.2 Objective

The objectives of this project are to:

- Develop a product design of portable nail puller products for woodwork
- Test the product design functionality of portable nail puller products using engineering simulation applications on wood construction processes.

2. Methodology

In this process, research methodology conducted is used to obtain all the information and things related to the design of this nail puller. As such, the selection of components is also an important factor in the production of this product, because the selection of the right components in the manufacture of the product will ensure that the product meets the set requirements and therefore helps save costs for this nail puller.

Phase 1: Analysis

The first phase of the ADDIE model is the analysis phase. This study involves identifying problems that need to be solved by the researcher. There are several studies studied by researchers to solve the identified problems. Therefore, researchers can produce this product. First researcher find the problem and it need to be identified first before producing a project to ensure the study can be completed well. The analysis identifies the problem of researchers to find out whether students have difficulty pulling

nails to avoid damage to their workpiece. Then, observation is required to ensure that the tool is designed to be of good quality. However, in identifying product needs, functional aspects should be taken into account, as this is very important in product creation. The design produced should have criteria such as easy to operate, medium size, portable and low maintenance cost. It is important to emphasize the safety and durability aspects of the product. This is to ensure the safety of the user while using the product, and the durability of the product is durable.

Phase 2: Product Design

The design phase is completed and the design requirements of the finished product are identified. The design phase includes an initial sketch of the product design researcher want to create. In addition, it is necessary to take into account the selection of materials, sizes and equipment that fit the design to meet the criteria of the product to be developed. This design requires at least three suggestions for the initial sketch to obtain a suitable design. Researchers have suggested some design ideas to form design concepts in design proposals. The design concept of the combination must meet the appropriate design criteria and function well. Design choices are then made based on developed concepts. Researchers use matrix-based evaluation methods to select appropriate designs. Choosing the right design is very important because it will determine the objectives of the study achieved or not. Figure 1 shows the design that researcher choose:

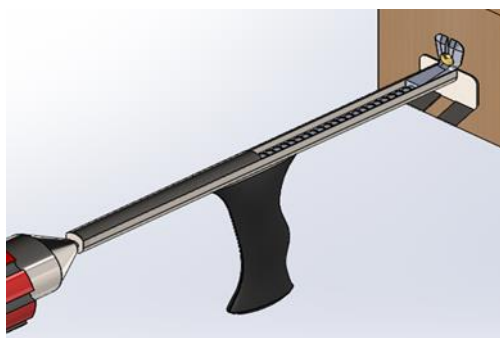


Figure 1: Selected Design

Phase 3: Development

At this stage the researcher must carry out the planned product development phase in the previous phase. Materials and components are also very important when developing a design. A very important part of the design process is the right choice of materials (Siregar, Herlambang & Sharif, 2018). The design and the choice of materials and components used must be taken into consideration to achieve the best outcome.

Phase 4: Implementation

The fourth phase in the ADDIE model is the implementation phase. This phase of model design will begin after all the material preparation work has been completed perfectly. The implementation phase covers the entire work process and presents the building materials. This process also involves a lot of activities and uses of workshops, mainly using the tools and equipment. Researchers will perform product development work within the specified time during this phase.

Phase 5: Evaluation

The final phase of the ADDIE model is the analysis phase. The researcher will test the design that has been developed during this phase. Researchers will use the questionnaire as a research tool to get feedback from experts in product evaluation and 10 respondents who test the functionality of student products. By using questionnaires, the accuracy and truth of the research conducted can be improved. The questionnaire to be distributed includes items as shown in Table 1.

Table 1: Questionnaire Form

Section	Details
A	Demographic respondent
B	Feedback on the design of portable nail pullers
C	Feedback on the development of portable nail puller
D	Feedback on the functionality of portable nail puller.

3. Results and Discussion

This section describes expert feedback and suggestion for improvements to the simulation of the nail puller. This simulation has been conducted with the confirmation and evaluation test by the expert himself by filling in the confirmation form and expert evaluation provided. This aims to confirm for the Simulation of the Nail Pull Tool produced to coincide with the objectives and research questions that the researcher wants to achieve. All three experts involved in the process of verification and evaluation of these experts have qualified for evaluation.

This demographic study has four parts namely gender, age, experience in the field of mechanical and educational institutions or employment in the mechanical sector. Table 2 shows the demographic analysis that has been stated in the questionnaire

Table 2: Expert Analysis of Demographic Studies

	Expert 1	Expert 2	Expert 3
Gender	Male	Male	Male
Age	35 and above	35 and above	35 and above
Experience in the field of mechanical	11years and above	11 years and above	11 years and above
Institutions of study or employment in the mechanical sector	Others	Others	Others

The development of this Simulation of the Nail Puller is to develop the design and functionality of the nail pull simulation for students in institutions and schools. Therefore, the researcher analyses the suitability of the product and its functionality by obtaining confirmation from the experts. All experts were given a checklist for the evaluation of Simulation of Automatic Nail Puller and Table 3 was shown the percentage of analysis of the design aspects of Simulation of Automatic Nail Puller that has been rated by experts.

Table 3: Percentage Analysis of Design Aspects of Simulation Nail Puller

No.	Question	Expert			Percentage of agreement
		1	2	3	
1.	Can the design of this portable nail puller save users time?	/	/	/	100%
2.	Can the design of this portable nail puller provide comfort to the user?	/	/	/	100%
3.	Does the design of this portable nail puller meet the safety features to the users	/	/	/	100%
4.	Is the design of this portable nail puller portable to the user?	/	/	/	100%
5.	In terms of product durability does the design of this portable nail puller have quality product features?	/	/	/	100%

This section discusses with expert analysis of the development aspects of Simulation Nail Puller. Table 4 shows the expert analysis of this development aspect has some questions.

Table 4: Percentage Analysis of Development Aspects of Simulation Nail Puller

No.	Question	Expert			Percentage of agreement
		1	2	3	
1.	Does the development of this design meet the security features to the users?	/	/	/	100%
2.	Does the development of this design indicate that this nail puller is portable?	/	/	/	100%
3.	Does the design development of this tool have high quality?	/	/	/	100%
4.	Is the design development of this tool able to fill the needs of users?	/	/	/	100%
5.	Is the development of this tool design a new innovation for users?	/	/	/	100%

This section is related to functionality. This part of the functionality aspect is only eight questions where it is to study the functionality on the whole Simulation of Automatic Nail Puller for Practical Training that has been developed. Table 5 shows the simulation design aspects of the Automatic Nail Puller obtained by the three experts.

Table 5: Percentage Analysis of Functionality of Simulation of Automatic Nail Puller

No.	Question	Expert			Percentage of agreement
		1	2	3	
Portable					
1.	Does this design provide convenience to users compared to existing equipment on the market?	/	/	/	100%
2.	Is this tool suitable for use in a small space?	/	/	/	100%
Durability					
3.	Does the design of this tool have high resistance to removing nails?	/	/	/	100%
4.	Does the material used for this nail puller have strong durability properties?	/	/	/	100%
Skill					
5.	The development of this product will the design be able to improve students skills?	/	/	/	100%
6.	This tool can help students who are less skilled in removing nails?	/	/	/	100%
7.	The design of this tool can reduce the waste of consumer energy?	/	/	/	100%
Users					
8.	Is this tool able to reduce the problem of users to remove nails without damaging the workpiece?	/	/	/	100%
9.	Is this handheld able to increase the comfort to the user?	/	/	/	100%
10.	The availability of this tool will improve the quality of the workpiece?	/	/	/	100%
Safety					
11.	The design of the handheld on this tool can reduce vibration while doing practical work?	/	/	/	100%
12.	This design capable of producing a safe level of use when developed?	/	/	/	100%

4. Conclusion

In this section, the data analysis chapter has been made for evaluation for the development of design and functionality developed and show positive effects. However, the findings of the analysis obtained by the researcher shows good results, the researcher still emphasizes on the shortcomings and weaknesses that exist, especially everything that has been commented by the evaluator in the improvement section. To answer this research question, analysis was conducted in chapter four and this shows that this question has been successfully answered by the researcher by understanding the design model, design analysis, simulation development, implementation process and evaluation. Design features and considerations that need to be emphasized and given more careful attention before producing the design of this nail puller. The features listed are based on the needs of consumers who will adopt this product. Among them are user-friendly, safety, practicality, and design quality.

The development of this Simulation Nail Puller is an effort that can help troubled users. The development of this simulation was developed using the ADDIE model as a platform for the development process of this nail puller. Researchers used the appropriate software in developing this simulation which is Solid works software and this software displays the movement of the tools developed. According to Hargas (2001), this simulation is as realistic and almost identical to the actual situation. This simulation can be concluded as a situation created aiming to imitate the experience in reality. This simulation can be defined as a situation created to resemble a real controlled situation. The researcher tests whether the product being developed can function according to what is planned or otherwise. Furthermore, according to the analytical data obtained by the researcher in chapter five, the researcher found that the simulation development of this nail puller tool was developed successfully and can save waste on the user's material or energy.

Based on the evaluation carried out by the evaluator experts, they agree with the development of this Simulation in the hope of giving the user an idea of how this tool moves. The researcher was able to conclude that this simulation successfully achieved its development objectives and goals. However, there are still improvements that can be made to achieve the highest level of simulation functionality of this tool.

References

- A Abd. Hamid, A.L. (2012). Amalan Keselamatan Bengkel Dalam Kalangan Pelajar Kolej Kemahiran Tinggi Mara. Fakulti Pendidikan Teknikal dan Vokasional Universiti Tun Hussein Onn Malaysia.
- Abdullah, A. A. (2019) Pembangunan Reka Bentuk Produk Penarik Paku Universiti Kuala Lumpur Malaysia France Institute
- Bakar, N. A. (2012). Penguasaan Amalan Keselamatan Bengkel di Kalangan Pelajar Kursus Elektrik di salah Sebuah Kolej Komuniti Negeri Selangor (Doctoral dissertation, Universiti Teknologi Malaysia)
- Nahar, N., Sangi, S., B. Salvam, D. A., Rosli, N., & Abdullah, A. H. (2018). Impak Negatif Teknologi Moden Dalam Kehidupan Dan Perkembangan Kanak-Kanak Hingga Usia Remaja (Negative Impact of Modern Technology To the Children'S Life and Their Development). *UMRAN - International Journal of Islamic and Civilizational Studies*, 5(1), 87–99
- Hargas, H., Callaghan, V. & Collry, M. 2001. Outdoor Mobile Robot Learning and Adaptation. *Robotics & Automation Magazine, IEEE* 8(3): 53-69.
- Haniffa, M. A., Mohamad, N. A., & Sham Rambely, N. A. (2018). Survival Orang Melayu Mendepani Arus Revolusi Perindustrian 4.0: Suatu Penelitian Awal. eProsiding Persidangan Antarabangsa Sains Sosial dan Kemanusiaan 2018.

- Raykar, S. J., D'Addona, D. M., & Kramar, D. (2014). Analysis of Surface Topology in Dry Machining of EN-8 Steel. *Procedia Materials Science*, 6(Icmpc), 931– 938.
- Siregar, R. E., Herlambang, Y., & Syarif, E. B. (2018). Saung dalam Perspektif Material yang Tepat dan Menunjang Visual. *e-Proceedings of Art & Design*, 5(3): 3937–3944.