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Research Article

Eraser Holder with Scraper

Amando A. Edradan, Jr. [1]
[1] *Palawan State University-Palawan, College of Arts and Trades, Cuyo, 5318 Palawan*
Email: aedradan@psu.palawan@edu.ph, Orcid: https://orcid.org/0009-0008-5199-5307

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ABSTRACT

The study aimed to design, construct, and evaluate an eraser holder with a scraper to minimise messiness and residue collected from the user. The holder cleaned the eraser when inserted and storage when not in use. It featured a unique scraping mechanism that minimised messiness and constant inhalation of the powdery substance from the eraser when writing and erasing the writings on the board. The performance of the device was tested using a combination of actual testing and a rating scale to establish a structured and objective assessment compared to general observations. Results found that the device's overall mean of 1.33 suggests the system's effectiveness in achieving study objectives and considering users' health benefits. Further research is recommended to identify flaws and improve its effectiveness.

Keywords: Whiteboard writing tool, Tool for presentations and discussions, Minimise messiness and residue

INTRODUCTION

A whiteboard marker is an essential tool for class presentations and discussions. Although digital presentations are widely used today due to the advent of computers, manual presentations and discussions through boards or whiteboards still play a significant role in learning delivery.

This tool surpasses the chalk's capacity due to several studies that found chalk to be harmful if inhaled by the user. Despite the popularity of the whiteboard marker, there are issues to consider, like the messiness when erasing is made, which leaves the powder residue on the hands of the user.

Writing with pens or markers on hands is not recommended due to potential skin abrasion and difficulty removing ink, which can cause inflammation or discolouration. Instead, use non-toxic, washable markers or pens, avoid covering a large area, and avoid excessive skin coverage (quora.com, 2024).

According to the Environmental Protection Agency (2024), many dry-erase markers in classrooms contain a chemical linked to serious health problems. Teachers should learn to identify this dangerous chemical and make safer choices for whiteboards to prevent health issues caused by chalk. They further discussed that dry-erase markers contain 2-butanone, a chemical linked to neurological, liver, renal, respiratory, eye, nose, and throat irritations, highlighting the need for safer alternatives. Moreover, misplacement of the marker when not in use resulted in losing it.

Ideally, the whiteboard pen is used in writing, and prolonged exposure will result in health issues, according to some studies (Health direct.gov, 2023). A whiteboard eraser is used to erase the writing. Conventional whiteboard erasers dropped powdery particles on the skin, particularly on the palm or hand of the user, which caused messiness and inhalation. To minimise these concerns, a device which will minimise residue contamination and inhalation was conceptualised to minimise these issues. To address this gap, a new and unique design for users to minimise messiness on the hands and inhalation through the specially designed container that scrapes excess powdery substance from the eraser.

Green and Shanbour II (2019) created a new marker holder and eraser design. It has two marker retention apertures on the front and back sides, a metal plate, a magnet holder, and an erasing substance. Projections can engage markers at any angle; however, holding the eraser body might be difficult because of the projection opening.

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Funi Stationery Commodity Co Ltd (2020) suggests that blackboard erasers are commonly used to wipe traces left by writing on whiteboards in teaching and business work. However, they require storing chalk and marker pens in inconvenient storage boxes, which can be easily prone to falling due to accidental touching. Hall, Reynolds, Christopher, and Fox's utility holder, designed in 2018, extends the lifespan of stored markers by featuring cylindrical recesses with a tapered bottom for holding a dry-erase marker cap, enabling the marker to be placed upside down and snapped into the cap but leaving power residue on the palm or the hand of the user.

The current state-of-the-art whiteboard holder for erasers has limitations, including a mechanism for messiness and untidiness caused by residue and possible inhalation of powder residues from the board and eraser. However, they address compactness, storage, and high-quality materials. Nonetheless, residue collection was not properly given attention to the tendency to inhale the powdery particles user's health conditions. As a result, a study was conceived to address these limitations and improve eraser holders with scraper performance.

PRIOR ARTS

When conducting a developmental study on the most efficient means of creating or innovating a new technology, particularly a tool or device, look for the closest prior art. This prior art is a guide to support and set the new technology apart from the old one.

The claims and backdrop of the investigation guide the researcher in determining the current design's strengths and weaknesses. The flaw demonstrated that there may be a way to create a new design and address the issue with the current one. Legally speaking, the researcher was guided by earlier art to avoid replicating an existing design.

2.1. Prior Art 1: Blackboard Eraser with Storage Function

Shishi Funi Stationery Commodity Co Ltd (2020). "Blackboard eraser with storage function" with Patent Number CN212098186U. At present, blackboard erasers are widely used in teaching and business work. They are usually used with chalk and markers to wipe the traces left by writing on the blackboard or whiteboard to facilitate rewriting. This is for blackboards without storage boxes or storage pallets. Usually, we need to set up a storage box for chalk and marker pens, which is inconvenient and easy to fall due to accidental touching. Chinese patent application number CN201410590307 discloses a blackboard eraser with a chalk storage box. The blackboard eraser is provided with a chalk storage box with a buckle cover on the board body. When used, a small amount of spare chalk can be placed in the chalk box, avoiding frequent and repeated use of the chalk and blackboard eraser. The trouble caused by chalk and blackboard eraser is beneficial to improve work efficiency; however, in actual use of the structure, the buckle cover is convenient for storing the chalk, but it is not convenient to take and place when in use, and the blackboard eraser is easy to fall during use—the tendency to inhale the powder particles and messy hands after the operation was not addressed.

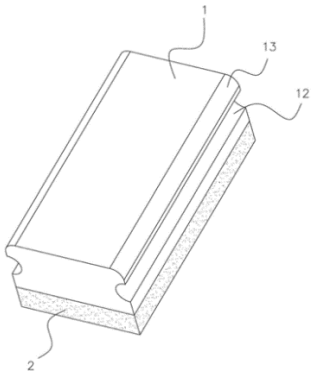

Figure 1. Blackboard eraser with storage function

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2.2. Prior Art 2: Marker Holder and Eraser

In the study of Green and Shanbour II (2019). Marker Holder and Eraser with US Patent No. 10328742B2. A new marker holder and eraser design has front and back sides, with the back having a recess. The front side has two openings for retaining markers. A metal plate and a magnet holder are disposed of within the recess, and an erasing material covers the recess. Projections extend from the magnet holder into openings on the front side to engage markers disposed in the openings, thereby holding the markers at any angle. There is a limit in handling the eraser body due to the insertion in the projection opening. The pen inserted needs to be pulled out for cleaning. This will result in a laborious process—the tendency to inhale the powder particles and messy hands after the operation was not addressed.

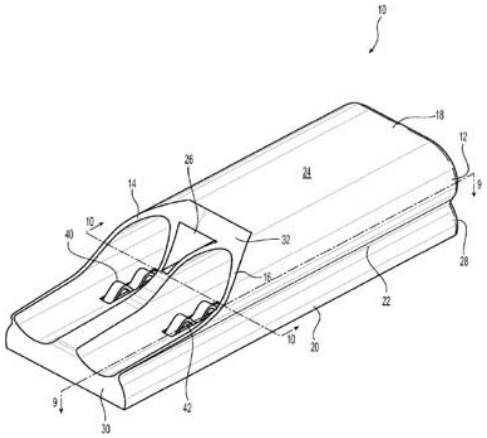

Figure 2. Marker Holder and Eraser

2.3. Nearest Prior Art: Magnetic Whiteboard Utility Holder

Hall, Reynolds, Christopher, and Fox (2018). Magnetic whiteboard utility holder with US Patent No. US9969208B1. The utility holder was designed to allow stored markers an extended life of working effectiveness. The design has one or more cylindrical recesses with a tapered bottom in which a dry-erase marker cap may be held in place so that a dry-erase marker may be placed inside the cylindrical recess upside down, snapping into the dry-erase marker cap. The upside-down placement of the markers in the magnetic whiteboard utility holder allows the markers maximum life. There are one or more magnets on the back surface of the utility holder, which allows it to adhere to a magnetic whiteboard. The utility holder also has a cuboid recess, allowing a dry-erase eraser for storage only. Still, it also has a special and unique feature for minimising the direct contact of the residue with the user's skin. Furthermore, inhalation of the powdery substance was not given attention.

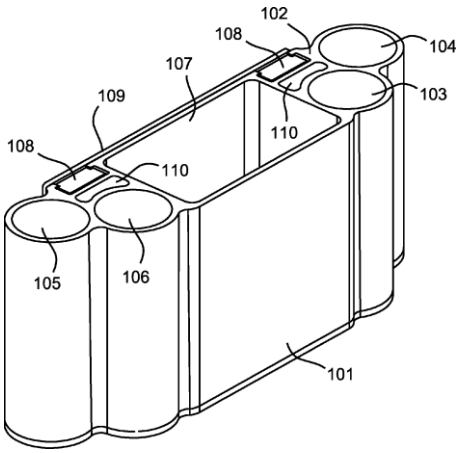

Figure 3. Magnetic Whiteboard Utility Holder

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SYNTHESIS

Based on the literature reviewed on the technologies of eraser holders with scrapers, the following was observed:

Shishi Funi Stationery Commodity Co Ltd has developed a blackboard eraser with a storage function, patent number CN212098186U. This innovative solution improves work efficiency by storing chalk and markers in a convenient, easy-to-access storage box. The device also allows for the placement of spare chalk, reducing the need for frequent use. However, the buckle cover is not user-friendly, easy to fall during use, non-replaceable, and has no special or unique features to minimise the spread of powdery particles from the eraser that are potentially harmful if inhaled by the user.

Green and Shanbour II's study presents a new marker holder and eraser design with a front and back side, a recess, and projections for marker engagement designed for storage only. However, there is no special feature to scrape and clean the eraser. The patent number 10328742B2 is not addressed.

Hall, Reynolds, Christopher, and Fox's 2018 magnetic whiteboard utility holder, US Patent No. US9969208B1 extends the life of stored markers by using cylindrical recesses with tapered bottoms for holding dry-erase markers. The holder also features magnets for adhesion to magnetic whiteboards and a cuboid recess for storing dry-erase erasers. However, no unique scraping mechanism was provided.

The identified state-of-the-art eraser holder was limited only to storing any whiteboard eraser. In this context, the researcher will design a holder with a unique scaping mechanism to clean the eraser, minimising the contamination and inhalation of powdery particles on the user during presentations or conducting classes.

OBJECTIVES OF THE STUDY

Generally, this study aimed to design, construct, and evaluate the eraser holder with a scraper. Specifically, this study aimed to design and construct the eraser holder with a scraper and assess the device's operating performance regarding messiness and residue collection.

SIGNIFICANCE OF THE TECHNOLOGY

This device is designed for the school supply industry and provides supplies for the offices and schools for lectures, classes, and presentations. Furthermore, the eraser holder with the scraper primarily focused on the replaceable feature that specifically accommodates a 5x2x1-inch conventional whiteboard eraser. The ergonomically designed body protects the user's hand while erasing the board's writings. While the container is equipped, it is intended to pad the entire device's body with a special container feature that can scrape the pads after erasing operations. Combined with the ergonomic body for effective gripping and handling without stressing the palm to do the expected operation. Moreover, the researcher also considered the health benefits of using the device to minimise the inhalation of powdery substances, potentially harmful to the body. As a result, this technology outperformed the current state-of-the-art eraser technology in messiness and residue collection.

METHODOLOGY

6.1. Fabrication of the Device

The design and plan were built at Iloilo Science and Technology University (ISAT U), FabLab, Research Hub, New Site, Burgos St., La Paz, Iloilo City. The completed device was subjected to technical evaluation by the experts based on the standard evaluation questionnaire set by the College of Industrial Technology Graduate Education Program. After the experts had assessed the device, it was revised based on their suggestions and comments.

6.2. The Instrumentation and Data Gathering Procedure

Two parameters were evaluated. The first test was the messiness of the erasers when used with a microscope. Nonetheless, residue from the user's hand was collected using an analytical balance.

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The instrument is based on actual testing. A rating scale was utilised to establish a structured and objective assessment compared to general observation, which involves observing a subject and assigning it a value based on a predetermined set of criteria. These criteria can be numerical, descriptive, or a combination of both.

To gather the needed data for the study, the laboratory science research assistant of ISAT U conducted three trials to eliminate biases in the experiments. Then, the user erased the ink on the board in three trials. Each trial measured the collected residue on the user's hand and from the eraser passing through the holder's scraper.

A dropper containing 1ml of whiteboard ink is dropped on the board and erased using the eraser to perform the messiness. After the erasing operation, the hand is evaluated visually and rated according to the respondent's perception.

An analytical balance was used for the residue collection. Before the experiment, the scraper's container was tared to adjust (a scale on which an empty container had been placed) to reduce the display weight to zero.

After this, the eraser was scraped by the container scraper; the collected residue was subjected to a volume test using an analytical balance. Each experiment was recorded using the researcher-designed questionnaire. However, the second part of the evaluation measured the messiness: 4 was none, 3 was a low presence of messiness, 2 was a high presence of messiness, and 1 was a very high presence of messiness.

For collected residue. A rating scale was also utilised: 4 is very dense, 3 is dense, 2 is fairly dense, and 1 is none. This test used an analytical balance and a microscope.

The result was then collected, collated, and processed using MS Excel 2021. The statistical tool used was the mean, which was used to determine the visual observation and the accumulated residue from the eraser.

Figure 4. Rating Scale for Evaluation of the Device

Rating Scale	Description	Interpretation
3.26-4.00	None	None
2.51-3.25	Low presence of messiness	The user’s hand is fairly messy
1.76-2.50	High presence of messiness	The user’s hand is messy
1.00-1.75	Very high presence of messiness	The user’s hand is very messy

Rating Scale for Messiness

Rating Scale	Description	Interpretation
3.26-4.00	Very dense	100% collected after the eraser scraped to the container
2.51-3.25	Dense	75% collected after the eraser scraped to the container
1.76-2.50	Fairly dense	50% collected after the eraser scraped to the container
1.00-1.75	Not dense	25% collected after the eraser scraped to the container

Rating Scale for Residue Collection

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RESULTS AND DISCUSSION

Table 1. Messiness

Trials	Messiness	Description	Interpretation
1	3.00	Low presence of messiness	The user's hand is fairly messy
2	3.00	Low presence of messiness	The user's hand is fairly messy
3	3.00	Low presence of messiness	The user's hand is fairly messy
Mean	**3.00**	**Low presence of messiness**	**The user's hand is fairly messy**

The study found that the eraser holder with scraper effectively minimised messiness in hands after use, with a mean of 3.00, which is described as a **low presence of messiness** and **interpreted as a user's hand being fairly messy**. This indicates its potential for use by lecturers, presenters, and teachers in conducting presentations, thereby possessing a quality to reduce the presence of residue for the user's inhalation.

Table 2. Residue Collection

Trials	Residue Collection	Description	Interpretation
1	1.00	Not dense	25% collected after the eraser scraped to the container
2	1.00	Not dense	25% collected after the eraser scraped to the container
3	2.00	Not dense	25% collected after the eraser scraped to the container
Mean	**1.33**	**Not dense**	**25% collected after the eraser scraped to the container**

The study found that the container's unique residue collection system efficiently and effectively collected powdery substances, making it useful for board work and presentation. Most trials showed no residue, but the overall mean of 1.33 suggests the system's effectiveness in achieving the study's objectives, considering the health benefits for users.

CONCLUSION

Using the eraser holder with the scraper resulted in fewer powdery substances on the skin, as visually observed during the experiment. Moreover, the device is not 100 per cent effective and efficient; however, it slightly eradicates the marks left by the whiteboard marker, which means it minimises residue. The container's special residue collection mechanism effectively and efficiently collects powdered substances, making it ideal for board work and presentations. While most trials revealed no residue, it successfully reached the study's goals while considering users' health benefits. Therefore, the container collection reflects that it collects only 25% after scraping the eraser into the container.

RECOMMENDATIONS

1. To the school supply industry, to manufacture the device for production, commercialisation, and utilisation of the target users.
2. Teachers, presenters, and lecturers should utilise the eraser holder with a scraper due to its compactness and versatility.

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3. The fellow faculty utilised the prototype to show its device to fellow faculty of the university that it possessed state-of-the-art technology incomparable to the existing whiteboard eraser technology.
4. Other researchers should conduct further studies to examine the present device's flaws and problems and devise a way to overcome its limitations and weaknesses.

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