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Original Research

EVALUATION OF A MODIFIED FLY GRILL FOR FLY-DENSITY SURVEILLANCE PRACTICUM

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ABSTRACT

Evaluation of a Modified Fly Grill for Fly-Density Surveillance Practicum. *Conventional Fly Grills are simple and useful tools for fly-density surveillance; however, their size, weight, and storage requirements may limit repeated use during field practicum. A foldable and rollable Fly Grill model was developed to improve portability while maintaining its core measurement function. This study aimed to evaluate student acceptance of the modified Fly Grill as a practical learning tool. A descriptive evaluative cross-sectional survey was conducted among fourth-semester students of the Department of Environmental Health, Poltekkes Kemenkes Banjarmasin, following direct use of six modified Fly Grill units during practicum. Ninety-five valid respondents completed a 33-item, four-point Likert-scale questionnaire covering ease of use, portability, comfort, and general perception. Data were analyzed descriptively using frequencies, means, and standard deviations. The modified Fly Grill received highly favorable ratings across all domains, with mean scores of 3.72±0.40 for ease of use, 3.68±0.42 for general perception, 3.65±0.45 for portability, and 3.64±0.45 for comfort. The highest item-level scores were observed for ease of understanding the instructions and relocating the device (both 3.77±0.45), followed by ease of setup (3.75±0.44). Lower ratings were found for device weight (3.61±0.49), handle/structural comfort and stability (both 3.62±0.51), and user safety (3.63±0.49), although all remained positive. The modified Fly Grill demonstrated high student acceptance and potential as a portable and reusable practicum tool. However, this study evaluated perceptions and acceptance only; technical performance, durability, and learning outcomes were not assessed. Further comparative studies using objective measures are recommended.*

INTRODUCTION

The housefly (*Musca domestica*) is a synanthropic insect that interacts closely with waste, decaying organic matter, food, animals, and humans, making it a potential mechanical carrier of various pathogenic microorganisms. A systematic review and meta-analysis showed that houseflies can carry pathogenic bacteria, including antimicrobial-resistant strains[1]. while a review of 99 studies identified more than 130 human pathogens associated with houseflies[2]. Field studies have also demonstrated the presence of bacteria such as *Staphylococcus*, *Bacillus*, and *Enterococcus*, including biofilm-forming and multidrug-resistant isolates[3]. n and around hospital environments, *Staphylococcus aureus* was detected in 208 of 400 examined flies, with resistance to several antibiotics exceeding 80%[4]. These findings underscore the importance of fly-density monitoring as a component of integrated fly control, particularly in the context of antimicrobial resistance and the limitations of chemical control measures[5]. Experimental evidence that flies can acquire and retain infectious materials, including viral ORF DNA and *Chlamydia trachomatis*, further emphasizes the need for consistent surveillance[6,7].

The *Fly Grill* is a simple device used to count flies landing on a gridded surface during a specified observation period and is widely used in environmental health education for teaching fly-density surveillance. However, conventional *Fly Grills* are relatively large and heavy, making them less practical for repeated transportation and storage. At the same time, the physical characteristics of the device need to be maintained because they may influence fly landing behavior. Several studies have shown that variations in *Fly Grill* color can affect the number of fly landings[8,9]. Studies using different yellow color variations also reported significant differences in mean fly density ($p=0.028$)[10]. while observations at a fish auction site found a mean of 16.0 flies on a dark-yellow device compared with 8.5 flies on an unpainted device[11]. These findings indicate that *Fly Grill* innovation should improve practicality without altering device attributes that may influence measurement outcomes.

Previous *Fly Grill* developments have included the addition of adhesive materials to extend its function from monitoring to fly capture[12]. lthough this approach may be useful for specific purposes, modifications to the device components may also alter its use, maintenance, and interpretation of results. As an alternative, a foldable and rollable model was developed to reduce the burden of transportation without changing the basic measurement principle. Field evaluation of this model found no statistically significant difference compared with the standard *Fly Grill*, providing preliminary technical support for its use[13]. The application of the *Fly Grill* in fly-control education has also demonstrated that surveillance devices can serve as learning media for the prevention of foodborne diseases[14].

Although technical equivalence is an important consideration, the successful implementation of practicum equipment is also influenced by users' experiences and acceptance. Positive user experiences may influence technology use intentions and learning outcomes[15]. Post-use evaluations of virtual laboratory technologies have shown that their potential benefits depend on students perceiving the tools as useful, easy to use, and suitable for repeated use[16]. A similar pattern has been reported for computer-based dental training systems, in which user evaluations following direct exposure provided information for decisions regarding routine implementation[17]. Learning effectiveness is also influenced by motivation, attitudes, the learning environment, and instructional conditions; therefore, evaluation of practicum equipment should not be limited to technical functionality alone[18].

The main research gap lies in the limited evidence regarding student acceptance of a modified *Fly Grill* following direct use in real practicum settings. Previous studies have primarily focused on measurement performance and the effects of design characteristics on fly landing behavior, whereas ease of use, portability, comfort, safety, independent use, and perceived educational value have not been systematically evaluated. Therefore, this study aimed to evaluate students' use and acceptance of the modified *Fly Grill* in the Department of Environmental Health, Poltekkes Kemenkes Banjarmasin, across four domains: ease of use, portability, comfort, and general perception of the device's performance and educational value. The novelty of this study lies in extending the existing technical evidence by incorporating a user-based evaluation of the modified *Fly Grill* in environmental health vocational education.

MATERIALS AND RESEARCH METHODS

This study employed a cross-sectional survey design. The evaluation was conducted after fourth-semester students of the Department of Environmental Health, Poltekkes Kemenkes Banjarmasin, had directly used the modified *Fly Grill* during a fly-density measurement practicum. A post-exposure design was selected to ensure that responses reflected actual user experiences rather than hypothetical judgments. Survey reporting was guided by the alignment between the research questions, sampling strategy, questionnaire design, response patterns, and data analysis[19].

The study population consisted of 125 students, including 59 students enrolled in the Diploma III in Sanitation program and 66 students enrolled in the Applied Bachelor's Program in Environmental Sanitation. The initial sample size was calculated using Slovin's formula with a 5% margin of error, yielding a target sample of 95 respondents. Proportional simple random sampling was planned, with 45 students selected from the Diploma III program and 50 from the Applied Bachelor's program. A total of 94 respondents provided analyzable data, corresponding to a response rate of 98.9% of the target sample. Two questionnaire items had 92 and 93 valid responses, respectively.

Six units of the foldable and rollable modified *Fly Grill* were produced based on a previously tested prototype. Before data collection, students received a brief orientation and training on device assembly, placement, observation, folding or rolling, cleaning, and storage. During the practicum, the device was placed at the designated observation point, and flies landing on the device were counted for 30 seconds; observations were repeated according to the surveillance procedure. After using the device, students completed a structured 33-item questionnaire covering four domains: ease of use, portability, comfort, and general perception. Responses were rated on a four-point scale: strongly agree=4, agree=3, disagree=2, and strongly disagree=1.

Instrument development and reporting should ideally address content validity, internal consistency, reliability, measurement error, and interpretability[20]. Documented expert review is also important to ensure adequate construct representation and item clarity[21], while usability instruments should address effectiveness, efficiency, learnability, comfort, and satisfaction[22]. Similar approaches have been applied in evaluations of clinical learning environments and the validation of Indonesian-language instruments[23,24]. In this study, the 33-item instrument underwent a reliability test involving 30 respondents. The resulting Cronbach's alpha coefficient was 0.970, indicating very high internal consistency. The study data were analyzed descriptively using the number of valid responses, frequencies, percentages, means, and standard deviations. The presentation of response distributions and mean scores followed practices used in health technology acceptance surveys[25].

Figure 1. Design of the Modified *Fly Grill*

RESEARCH RESULTS AND DISCUSSION

Overall Implementation and Evaluation

All operational stages of the study were completed, including the production of six modified devices, orientation and training, use during the practicum, questionnaire administration, and descriptive analysis. Of the 95 participants initially targeted, 94 respondents provided data that could be analyzed. The number of analyzable respondents was considered sufficient for the descriptive analysis conducted in this study.

All four domains received high and relatively homogeneous mean scores (Table 1). Ease of use had the highest mean score (3.72±0.40), followed by general perception (3.68±0.42), portability (3.65±0.45), and comfort (3.64±0.45). The difference between the highest and lowest domain means was only 0.08 points. Thus, user acceptance was not limited to a single attribute but extended across operation, mobility, comfort, and perceptions of device function and educational value. This finding is consistent with the multidimensional concept of usability, which encompasses effectiveness, efficiency, learnability, comfort, and satisfaction[22].

Table 1. Respondents' assessment of the modified *Fly Grill* by domain

Domain	Number of valid responses*	Mean	Standard deviation
Ease of use	95	3.72	0.40
Portability	95	3.65	0.45
Comfort	95	3.64	0.45
General perception	95	3.68	0.42

*The number of valid responses represents the cumulative number of valid item-level responses within each domain and does not represent the number of unique respondents.

Ease of Use and Student Independence Ease of use had the highest domain mean (3.72±0.40). At the item level, understandable instructions and ease of moving the device to the measurement location received the highest mean scores, both at 3.77±0.45. Ease of assembly was also rated highly (3.75±0.44), while ease of folding or rolling the device after use received a mean score of 3.73±0.47. Overall, these findings indicate that students were able to understand and operate the device relatively easily after receiving brief training.

Positive user experiences have been associated with technology use intentions and may explain variations in learning outcomes[15]. In virtual laboratory technologies, post-use acceptance has also been influenced by perceived ease of use, usefulness, and willingness to adopt the technology[16]. Therefore, the high ratings for ease of use and independent operation support the potential for routine use of the device in practicum activities. However, these findings reflect user perceptions and do not demonstrate objective improvements in time efficiency or learning outcomes.

The relatively lower-rated items within this domain were ease of cleaning (3.64±0.55) and the perception that the device did not require much time to use (3.69±0.46). Responses concerning ease of cleaning also showed relatively greater variability. These findings indicate that post-use maintenance remains an aspect that may require attention in further device development, particularly to support repeated use.

Portability and Suitability for Field Practicum

The portability domain had a mean score of 3.65±0.45. Students rated the device highly in terms of suitability for field practicum (3.68±0.47) and ease of mobilization (3.67±0.49). Ease of placing the device into a bag or vehicle received a mean score of 3.64±0.52, whereas the perceived lightness of the device for field transportation received the lowest mean within this domain (3.61±0.49). These findings suggest that the foldable and rollable characteristics were perceived as beneficial for device mobilization, although its weight may still be improved.

The statement that the device did not require much storage space also received a mean score of 3.64±0.52. This finding indicates that portability involves not only ease of transportation but also storage requirements. Future development may therefore consider improvements to the folding and storage mechanisms without altering the device's essential characteristics. Design standardization should remain a priority. The color and surface characteristics of the *Fly Grill* have been shown to influence the number of fly landings[8–11]. Therefore, improvements to hinges, locking mechanisms, handles, and storage systems should not alter the color, grid dimensions, spacing between slats, or surface properties that may influence fly responses. User evaluation should be complemented by technical performance testing following each design revision.

Comfort, Safety, and Structural Performance

The comfort domain had a mean score of 3.64±0.45. General comfort during use received a mean score of 3.64±0.48, while comfort related to the handle or device structure received 3.62±0.51. Perceived safety received a mean score of 3.63±0.49, and device stability when placed on the ground or a table received 3.62±0.51. These findings indicate that students generally perceived the device as comfortable and safe, although several structural aspects received relatively lower scores than ease-of-use indicators.

This pattern suggests opportunities for ergonomic improvement, particularly regarding the handle, structural components, and device stability. However, further development should consider the balance between comfort, structural strength, weight, and portability so that improvements in one aspect do not compromise the benefits of another. Because these assessments were based on student perceptions, objective ergonomic and durability testing is warranted in future studies.

Perceived Performance, Educational Value, and Overall Acceptance

Within the general perception domain, students gave positive ratings to the device's functionality during the practicum. The device was perceived to function well for fly-density measurement (3.65±0.48), to provide an appropriate surface for fly landing (3.65±0.48), and to facilitate observation (3.66±0.50). The perceived ability to reuse the device also received a high rating (3.72±0.45), as did the perception that the device supported the practicum learning process (3.72±0.45). These findings indicate that students perceived the modified *Fly Grill* as appropriate for practicum activities.

The perception that the device performed equivalently to the standard *Fly Grill* received a mean score of 3.67±0.47. This finding is consistent with previous field evaluation, which found no significant difference between the foldable model and the standard *Fly Grill*[13]. However, perceived equivalence reported by students represents user perception and cannot be considered evidence of technical equivalence. Objective measurements of fly landings, observation accuracy, and measurement consistency are still required to confirm device performance.

Regarding acceptance, satisfaction with the modified *Fly Grill* received a mean score of 3.73±0.47, while willingness to use the device again was 3.68±0.47 and willingness to recommend it to other students was 3.72±0.45. The device was also considered suitable for routine practicum use, with a mean score of 3.69±0.46. Studies of other technology-based learning systems have shown that post-use evaluation can provide information regarding user acceptance for routine implementation[17]. The present findings therefore support the potential use of the modified *Fly Grill* as a practicum learning tool, particularly given the positive perceptions of ease of use, acceptance, and willingness to reuse the device.

A device that is easy to understand and can be operated independently may support the learning process by reducing activities that are not directly related to practicum objectives. Nevertheless, this study did not measure knowledge, skills, observation accuracy, or learning retention. Therefore, high scores for items indicating that the device supports learning or increases learning interest should not be interpreted as evidence of objectively improved learning outcomes.

Overall, the response distribution was dominated by the strongly agree and agree categories across almost all indicators, with some disagreeing responses for selected items and no strongly disagree responses. This pattern indicates strong user acceptance, although a potential ceiling effect and limited discrimination associated with the four-point response scale should be considered. Indonesian-language instruments may demonstrate good psychometric quality when formally evaluated[24]. Therefore, future evaluation should report content validity, factor structure, internal consistency, reliability, and item-level analysis in accordance with measurement guidelines[20,21].

Table 2. Descriptive Statistics for Individual Items Assessing the Modified *Fly Grill*

Indicator	n	Mean	SD	SA	A	DA	SDA
The instructions for using the device are easy to understand	95	3.77	0.45	74	20	1	0
The device is easy to assemble before use	95	3.75	0.44	71	24	0	0
The device is easy to fold/roll after use	95	3.73	0.47	70	24	1	0
The device is easy to move to the measurement location	95	3.77	0.45	74	20	1	0
The device is easy to clean after use	95	3.64	0.55	64	28	3	0
The device is easy to store after the practicum	95	3.74	0.44	70	25	0	0
The device does not require much time to use	95	3.69	0.46	66	29	0	0
I can use the device without assistance from others	95	3.67	0.49	65	29	1	0
The device is more compact than the standard *Fly Grill*	95	3.64	0.48	61	34	0	0
The device is light enough to carry to the field	95	3.61	0.49	58	37	0	0
The device is easy to place in a bag/vehicle	95	3.64	0.52	63	30	2	0
The device is suitable for field practicum	95	3.68	0.47	65	30	0	0
The device design facilitates mobilization	95	3.67	0.49	65	29	1	0
The device does not require much storage space	95	3.64	0.52	63	30	2	0
I feel comfortable using this device	95	3.64	0.48	61	34	0	0
The handle/device structure is comfortable to use	95	3.62	0.51	60	34	1	0
The device is safe to use and does not cause injury	95	3.63	0.49	60	35	0	0
The device is stable when placed on the ground/table	95	3.62	0.51	60	34	1	0
No part of the device interferes with its use	95	3.65	0.48	62	33	0	0
I do not become tired quickly when using this device	95	3.65	0.50	63	31	1	0
The device functions well in the fly-density practicum	95	3.65	0.48	62	33	0	0
Flies can land on the device properly	95	3.65	0.48	62	33	0	0
Observations are easy to perform	95	3.66	0.50	64	30	1	0
The device supports the practicum learning process	95	3.72	0.45	68	27	0	0
The device can be reused	95	3.72	0.45	68	27	0	0
The device material is sufficiently strong and durable	95	3.66	0.48	63	32	0	0
The device performs equivalently to the standard *Fly Grill*	95	3.67	0.47	64	31	0	0
The device is suitable for routine practicum use	95	3.69	0.46	66	29	0	0
I am satisfied with this modified *Fly Grill*	95	3.73	0.47	70	24	1	0
I would like to use this device again	95	3.68	0.47	65	30	0	0
I would recommend this device to other students	95	3.72	0.45	68	27	0	0
This device increases my interest in the practicum	95	3.66	0.52	65	28	2	0
Overall, this device is better than the previous device	95	3.67	0.47	64	31	0	0

Note: SD = standard deviation; SA = strongly agree; A = agree; DA = disagree; SDA = strongly disagree.

Limitations and Development Implications

This study has several limitations. First, the cross-sectional design captured user perceptions immediately after device use and did not assess device durability, long-term consistency of use, or sustained adoption. Second, the data were obtained from a single institution and were not analyzed according to study program or prior practicum experience. Third, responses were highly concentrated in the positive categories. Fourth, although internal consistency was assessed in this study, other psychometric properties, including content validity and factor structure, were not comprehensively evaluated. Fifth, the study did not compare assembly time, transportation burden, counting accuracy, inter-rater reliability, or learning outcomes with those obtained using the standard *Fly Grill*.

Despite these limitations, the study provides structured evidence that the portability-oriented modification was well accepted by end users. The six available units can support group-based learning activities, particularly when accompanied by standardized instructions, a usability checklist, cleaning procedures, and maintenance records. Further studies should combine user evaluation with objective measurements, including assembly and folding time, weight and storage volume, fly-landing counts under paired conditions, durability after repeated use cycles, inter-observer reliability, and changes in learning outcomes. The development of an automated fly-counting system may also be considered, provided that it does not alter surface characteristics that influence fly-landing behavior.

Conceptually, this study extends the development of the *Fly Grill* from technical evaluation toward user-based evaluation. The combination of previous technical evidence[13] and the user acceptance findings from the present study supports further stages of product development, manufacturing standardization, intellectual property protection, and multicenter evaluation. However, broader adoption should await further confirmation of instrument validity, performance equivalence across individual units, and educational effectiveness.

Figure 2 presents a visual summary of the background, study design, assessment domains, main findings, and implications of using the modified *Fly Grill* as a practicum tool for fly-density surveillance. Overall, the figure illustrates that the device received high user acceptance, particularly in terms of ease of use, general perception, portability, and comfort.

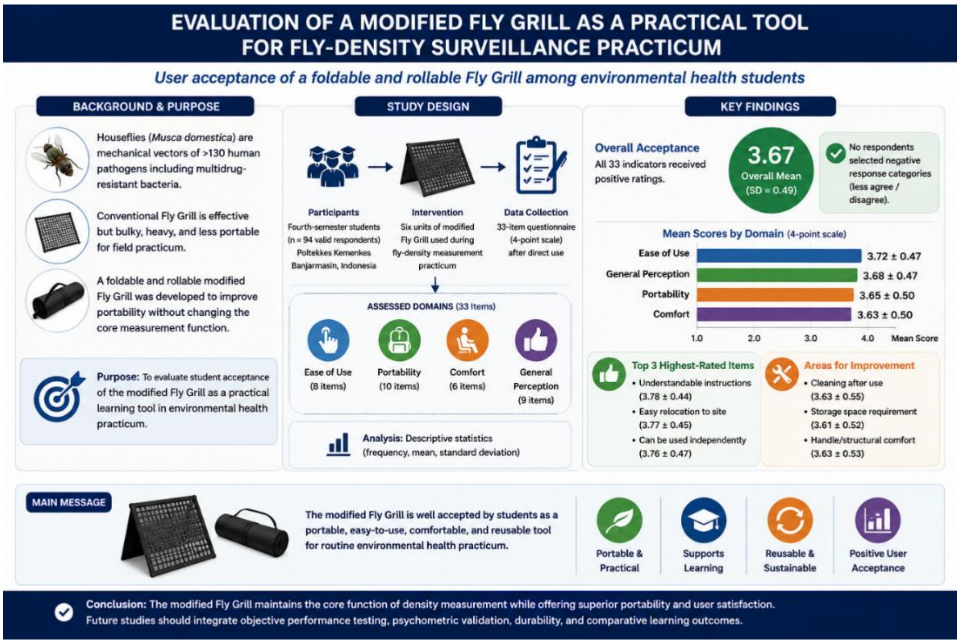

Figure 2. Graphical Summary of the Evaluation of the Modified *Fly Grill* as a Practicum Tool for Fly-Density Surveillance

CONCLUSIONS AND RECOMMENDATIONS

The modified *Fly Grill* received highly favorable acceptance from students following its use in fly-density surveillance practicum. Positive perceptions were observed across the domains of ease of use, portability, comfort, and overall perception of the device. These findings support the potential use of the modified *Fly Grill* as a portable and reusable practicum tool. However, this study was limited to evaluating user perceptions and therefore did not establish the device's objective technical performance or its effectiveness in improving learning outcomes.

Future studies should strengthen the evidence by conducting psychometric evaluation of the instrument, objective comparisons with the standard *Fly Grill*, durability and measurement reliability testing, and assessment of learning outcomes across more diverse populations and institutions. Further refinement of the device design and maintenance procedures should also be guided by user evaluation findings while preserving the characteristics of the device that may influence fly landing responses.

ETHICAL APPROVAL

Ethical approval was granted by the Health Research Ethics Committee (Komisi Etik Penelitian Kesehatan/KEPK) of Poltekkes Kemenkes Banjarmasin under Ethical Clearance Certificate No. 224/KEPK-PKB/2026.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest related to this study.

AUTHOR CONTRIBUTIONS

Siti Noor A'in A'fifah Puteri: conceptualization, study design, instrument development, coordination of data collection, data analysis, and manuscript writing**.** M. Rizki Imanuddin: device design development, data validation and processing, and statistical analysis. Adiansyah: device design development, user training, result interpretation, and manuscript review**.** Muhammad Pahruddin: validation, data processing, statistical analysis, literature search, and manuscript writing. All authors read and approved the final version of the manuscript.

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