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Advancing Poultry Breeding: Development of a Combined Egg Incubator and Hatchery †

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Abstract

This study designed, developed, and evaluated a combined egg incubator and hatchery system to enhance poultry breeding efficiency, reliability, and ergonomic operation. Utilizing a developmental research design, the project addressed challenges in traditional incubation and hatching processes, including inconsistent temperature and humidity control, inadequate ventilation, frequent power interruptions, limited access to affordable materials and technical expertise, insufficient safety mechanisms, and a lack of multifunctional capability. Data were collected from 30 experts in agricultural engineering and poultry technology to evaluate design, construction, material availability, functionality, usability, safety, modularity, and ergonomics. Findings revealed the system was highly efficient, safe, and user-centered, improving hatch rates and operator comfort.

Keywords: egg incubator–hatchery system; poultry incubation technology; poultry breeding efficiency

1. Introduction

Incubators are essential tools in the agriculture sector, particularly in poultry farming, as they enable the controlled hatching of eggs without relying on natural brooding, evolving from heated rooms in ancient Egypt and China to kerosene lamp-heated models and, more recently, to electric versions equipped with automatic turning systems and advanced temperature regulation [1]. While modern incubators have significantly improved hatching rates, they also present challenges, including high energy consumption, maintaining optimal air quality, and ensuring reliable environmental control. One significant challenge is accessing reliable, affordable materials and power sources, especially in remote areas.

This research aimed to address key limitations in existing incubator designs, particularly for small- to medium-scale farmers. While common features like automated temperature control and egg turning are widely available, crucial aspects such as precise humidity regulation, continuous airflow, and energy efficiency remain underdeveloped. Moreover, unreliable electricity access often undermines consistent performance. The innovative concept of an improvised egg incubator with integrated drying, humidity regulation, and power management systems addressed several limitations of current incubator designs. Maintaining optimal humidity and temperature levels is crucial for embryonic

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development in eggs [2]. Incorporating a humidity heater can improve indoor air quality and hatching success, potentially reducing respiratory issues in chicks [3]. Additionally, humidity control systems may help reduce the risk of respiratory illnesses, such as colds or flu, in the hatching area, a factor that significantly affects hatchling survivability and health [4].

By providing an accessible and user-friendly design, the model aimed to significantly improve hatching success rates and chick welfare. If chick embryos develop to the pipping stage or, at first, shell cracking at hatching, they are normally healthy enough to hatch unless an incubator adjustment prevents it [5]. The system integrated several advanced features to ensure optimal performance. An inverter mitigates temperature fluctuations during power outages, making it ideal for regions with unstable electricity. An exhaust fan is included to maintain proper ventilation, ensuring fresh air circulation and adequate oxygen levels necessary for embryo development. To enhance safety, a circuit breaker protects the system against malfunctions, ensuring reliability. A unique aspect of this design is its dual-purpose functionality, which incorporates a drying feature. This allows the incubator not only to hatch eggs but also to efficiently dry materials, providing added versatility for farmers and fishermen. By creating a controlled incubation environment and integrating multifunctional features, the system supports the development of healthy chicks while improving resource utilization, agricultural productivity, and operational efficiency.

This study specifically aimed to design a combination of an egg incubator and hatchery, develop a prototype, and evaluate it in terms of design, construction, material availability, functionality, usability, aesthetics, modularity, and ergonomics.

Figure 1 presents a schematic diagram of the study, based on the Input–Process–Output (IPO) model and serving as a guide for this study. Necessary resources and tools for the project were prepared, carefully selecting materials and equipment based on their precision, productivity, safety, and stability. In the process stage, the project underwent three phases, development, evaluation, and validation, before being made available to the target users. During the development phase, the necessary components were gathered and assembled step by step, ensuring that each element fit and functioned properly. The process began with establishing a strong, stable base for the table, followed by the precise and organized attachment of each component. Power tools were placed in their designated areas to ensure a practical, efficient setup. Each part was securely fastened to prevent shifting or loosening during operation, thereby maintaining safety and stability. After assembly, device performance was evaluated, and adjustments were made as needed to improve efficiency and reliability. As a result, the combined egg incubator and dryer machine was completed and made ready for use by the intended users.

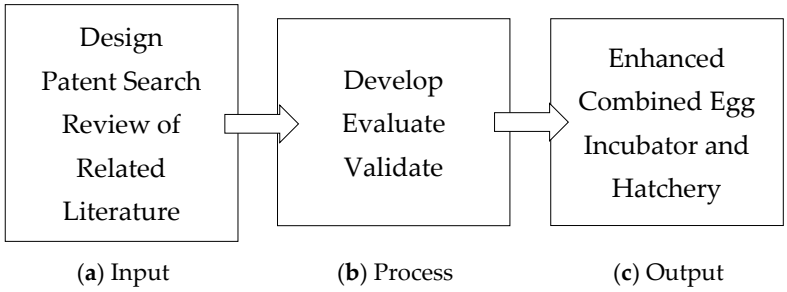


Figure 1. Schematic Diagram.

2. Methodology

This study employed a developmental research design to develop and test a combined egg incubator and hatchery. The developmental research, as opposed to simple instructional

development, is defined as "the systematic study of designing, developing, and evaluating instructional programs, processes, and products that must meet the criteria of internal consistency and effectiveness" [6]. In this context, the study involved designing, developing, and evaluating the combined egg incubator and hatchery.

The study was conducted at Caraga State University, Cabadbaran City, Agusan del Norte, involving 30 poultry farmers from the communities of Brgy. Basilisa, R.T.R., and Cabadbaran City, Agusan del Norte, who used egg incubators for hatching. A structured survey questionnaire was utilized to evaluate the device's performance. Descriptive statistical tools were effectively utilized to analyze the data in this study. Together, these statistical tools provided a precise, structured analysis of the data. They were instrumental in achieving the study's objectives, particularly in assessing the prototype's effectiveness in enhancing the hatchery and egg incubation processes.

3. Results and Discussion

Figure 2 shows the isometric view of the combined egg incubator and hatchery, marking a significant innovation in the poultry breeding industry. The system integrates essential components, including precise temperature control, humidity regulation, airflow management, and automatic egg turning mechanisms, to ensure optimal conditions for egg incubation and hatching. The final design reflects extensive research and technical expertise, promoting higher hatchability rates, improved chick health, and overall operational efficiency.



Figure 2. Isometric View of the Combined Egg Incubator and Hatchery.

The integrated incubator and hatchery streamlined the breeding process by minimizing the need for separate equipment, saving space and energy. Constructed with durable, energy-efficient materials, this system is scalable, making it suitable for both small-scale farms and large poultry operations. The user-friendly interface allowed easy monitoring and adjustment of critical parameters, providing farmers with real-time data to ensure the success of each hatching cycle. This combined incubator and hatchery system represented a major leap forward in poultry breeding technology, supporting higher productivity, better resource management, and more reliable outcomes for farmers worldwide.

Table 1 presents the experts' evaluation of the product's design, construction, and material availability, yielding an overall mean of 3.46 and a standard deviation of 0.07, corresponding to a verbal interpretation of "Strongly Agree." This indicates that the experts highly regard the product's thoughtful design, durable construction, and use of accessible materials.

Table 1. Experts' Evaluation of Product Development in Terms of Design, Construction, and Availability of Materials.

	Statement	Standard Deviation	Mean	Verbal Interpretation
1.	The product integrates essential safety features such as a breaker and thermostat for secure and reliable operation.	0.624	3.53	Strongly Agree
2.	The product is designed to be portable and compact, making it easy to move and install in various indoor spaces.	0.470	3.29	Strongly Agree
3.	The materials used in constructing the incubator (e.g., plywood, metal sheets, fans, heaters) are locally available.	0.606	3.35	Strongly Agree
4.	Vital components like the thermostat, fan, and humidity.	0.702	3.35	Strongly Agree
5.	The product requires only basic, commonly available tools and equipment for assembly.	0.624	3.47	Strongly Agree
6.	The construction materials and components are durable and capable of efficient performance over an extended period.	0.606	3.65	Strongly Agree
7.	The product features a technically simple design that users or students can easily understand and replicate.	0.514	3.47	Strongly Agree
8.	The structure is designed to maximize internal space for optimal egg incubation and drying functions.	0.507	3.41	Strongly Agree
9.	The product is well-suited for fabrication in school laboratories or local workshops using standard resources.	0.514	3.53	Strongly Agree
10.	The construction process of the product is straightforward, allowing others to replicate it with minimal instruction.	0.507	3.59	Strongly Agree
	Overall Mean	0.07	3.46	Strongly Agree

Legend: Strongly Disagree 1.00–1.75, Disagree 1.75–2.50, Agree 2.51–3.25, Strongly Agree 3.26–4.0.

The implications of these findings highlighted the product's strong potential for widespread adoption in educational and community-based settings. Its user-friendly design and reliance on readily available materials supported scalability, cost-effectiveness, and local production. Furthermore, its simple construction and durable features made it ideal for instructional use, promoting hands-on learning and encouraging innovation among students and local fabricators. Overall, the results demonstrated that the product not only met functional requirements but also aligned with sustainable and inclusive technology development goals. Reusing locally available materials enhances durability and sustainability—echoing your findings on accessible, long-lasting materials [7]. Expert evaluations are effective in validating material selection and structural quality, aligning with your approach in assessing construction reliability [8].

Table 2 presents the experts' evaluation of the product in terms of functionality, yielding an overall mean of 3.46 and a standard deviation of 0.07, corresponding to a verbal interpretation of "Strongly Agree. These findings suggest that the product effectively integrates multiple core functions—egg incubation, drying, and air quality enhancement—into

a single unit, thereby providing value to users seeking compact, efficient solutions. The strong scores across all items suggest that the product is not only functional and reliable but also user-responsive and adaptive to environmental changes. Its ability to maintain consistent operation with minimal adjustment also implies reduced user intervention and maintenance, making it suitable for both educational settings and practical field applications.

Table 2. Experts' Evaluation of Product Development in Terms of Functionality.

	Statement	Standard Deviation	Mean	Verbal Interpretation
1.	The product provides multifunctional capability combining egg incubation, drying, and air quality enhancement features.	0.493	3.65	Strongly Agree
2.	The product ensures operational accuracy through its thermostat, humidity sensor, and automatic egg-hatching mechanism.	0.437	3.76	Strongly Agree
3.	The product offers functional flexibility and operates effectively for incubation and drying tasks.	0.624	3.53	Strongly Agree
4.	The product delivers reliable performance across all intended functions (heating, humidity control, airflow, and drying).	0.470	3.71	Strongly Agree
5.	The techniques (e.g., controlled temperature and humidity, inverter for power supply) ensure efficient operation.	0.514	3.53	Strongly Agree
6.	The product meets all functional requirements outlined in its objectives—incubating eggs and maintaining humidity and airflow.	0.624	3.47	Strongly Agree
7.	The product provides accurate hatching conditions with precise temperature and humidity regulation.	0.507	3.59	Strongly Agree
8.	The product appropriately accomplishes its intended tasks, such as maintaining a proper incubation environment and drying capability.	0.493	3.65	Strongly Agree
9.	The product responds promptly to changes in environmental conditions via its automatic sensor and control system.	0.514	3.53	Strongly Agree
10.	The product functions consistently over time without requiring frequent adjustments or maintenance.	0.507	3.59	Strongly Agree
	Overall Mean	0.07	3.46	Strongly Agree

Legend: Strongly Disagree 1.00–1.75, Disagree 1.75–2.50, Agree 2.51–3.25, Strongly Agree 3.26–4.0.

Overall, the evaluation confirmed that the product met its functional goals and can support sustainable agricultural or educational initiatives. Automated control systems for temperature, humidity, and airflow significantly enhance drying efficiency and operational reliability—aligning with your findings on consistent performance and functional precision [9]. Likewise, real-time sensor monitoring improves functional adaptability and reduces the need for user intervention, reinforcing the effectiveness of your product's automated features [10].

Table 3 presents the experts' evaluation of the product's usability, with an overall mean of 3.58 and a standard deviation of 0.02, interpreted as Strongly Agree. The evaluation

indicates that experts found the product user-friendly, intuitive, and educationally valuable. These results imply that the product is highly usable not only in practical applications but also in educational contexts. Its simple operation, supported by automatic sensors, accessible controls, and clearly labeled components, helps minimize user error while enhancing operational safety. Furthermore, the product's usability encourages students and users to explore design, automation, and engineering innovation, making it an effective tool for teaching technical skills. The product's ease of handling and potential for mass production also suggest broader applications in community-based agricultural practices and technical and vocational education programs. Sensor-equipped, intuitive educational tools improved user engagement and self-directed learning—closely aligning with your findings on ease of use and educational impact [11]. Similarly, intuitive interfaces and integrated automation enhance user experience and learning efficiency, thereby supporting the usability and training effectiveness of your product [12].

Table 3. Experts' Evaluation of Product Development in Terms of Usability.

	Statement	Standard Deviation	Mean	Verbal Interpretation
1.	The product provides simple operation with easy-to-understand components such as the thermostat, breaker, and inverter.	0.507	3.41	Strongly Agree
2.	The product effectively translates incubation and drying principles into practical operations for real-life applications.	0.507	3.59	Strongly Agree
3.	The product can be used to teach temperature control.	0.514	3.53	Strongly Agree
4.	The product promotes learning by offering hands-on experience in egg incubation and basic automation.	0.493	3.65	Strongly Agree
5.	The product stimulates creativity through its integrated multifunctional system, encouraging design and engineering innovation.	0.470	3.71	Strongly Agree
6.	The product demonstrates usability as a working prototype suitable for scaling to mass production.	0.514	3.53	Strongly Agree
7.	The product lets users easily identify and understand each component's function (e.g., fan, sensor, heater).	0.470	3.71	Strongly Agree
8.	The user-friendly product allows safe and efficient handling without risk from heat, electricity, or moving parts.	0.514	3.47	Strongly Agree
9.	The product provides easy control and adjustment.	0.507	3.59	Strongly Agree
10.	The product helps minimize user errors by using automatic sensors and indicators to maintain optimal operating conditions.	0.507	3.59	Strongly Agree
	Overall Mean	0.02	3.58	Strongly Agree

Legend: Strongly Disagree 1.00–1.75, Disagree 1.75–2.50, Agree 2.51–3.25, Strongly Agree 3.26–4.0.

Table 4 presents the experts' evaluation of the product's aesthetics, with an overall mean of 3.58 and a standard deviation of 0.04, corresponding to a verbal rating of Strongly Agree. The findings highlight the product's visual appeal, functional design, and user-friendly layout. The implications of this evaluation suggest that the product is not only

functional but also visually compelling, enhancing both usability and user engagement. Its modern, organized appearance makes it suitable for educational and laboratory environments, where aesthetic value contributes to professional, stimulating learning spaces. Moreover, the product's distinctive form supports brand identity and recognition, potentially increasing its market potential and scalability. By aligning form with function, the design encourages intuitive use, making the product more accessible to learners and first-time users. Visually appealing, well-organized designs enhance usability and emotional comfort, reinforcing your findings that aesthetic quality increases user appeal in educational and laboratory contexts [13]. Similarly, distinctive, innovative design elements contribute to lasting user satisfaction and functional clarity, aligning with your product's unique form and multifunctional identity [14].

Table 4. Experts' Evaluation of Product Development in Terms of Aesthetics.

	Statement	Standard Deviation	Mean	Verbal Interpretation
1.	The product is visually distinguishable from standard incubators due to its integrated drying and air-quality features.	0.507	3.59	Strongly Agree
2.	The product demonstrates balanced proportions in shape, size, and component placement, contributing to an organized and professional appearance.	0.507	3.59	Strongly Agree
3.	The product incorporates functional design elements that align with its purpose, such as vent placement, display orientation, and compartment layout.	0.507	3.59	Strongly Agree
4.	The product's design reflects its function as an egg incubator and drying machine, making its use easy to understand at a glance.	0.514	3.53	Strongly Agree
5.	The product enhances the visual appeal of the area where it is placed, contributing positively to the workspace or laboratory setting.	0.514	3.53	Strongly Agree
6.	The product interface supports user interaction with a clean, uncluttered layout and visually accessible controls.	0.514	3.53	Strongly Agree
7.	The materials used in the product, such as metal, acrylic, or painted wood, enhance its appearance while maintaining functionality.	0.507	3.41	Strongly Agree
8.	The overall shape and form of the incubator project a modern and innovative aesthetic.	0.514	3.47	Strongly Agree
9.	The product's surface finish and texture contribute to a clean, polished appearance appropriate for educational or technical environments.	0.470	3.71	Strongly Agree
10.	The product's design is distinctive and stands out compared to conventional egg incubators and drying machines.	0.393	3.82	Strongly Agree
	Overall Mean	0.04	3.58	Strongly Agree

Legend: Strongly Disagree 1.00–1.75, Disagree 1.75–2.50, Agree 2.51–3.25, Strongly Agree 3.26–4.0.

Table 5 presents the experts' evaluation of the product's modularity, yielding an overall mean of 3.61 and a standard deviation of 0.03, indicating a verbal interpretation

of "Strongly Agree." The results indicate that the product features a high level of modular design, offering flexibility, intuitive operation, and ergonomic usability.

Table 5. Experts' Evaluation of Product Development in Terms of Modularity.

	Statement	Standard Deviation	Mean	Verbal Interpretation
1.	The product is designed at a comfortable working height, allowing adjustments to accommodate various user preferences during operation.	0.470	3.71	Strongly Agree
2.	The product supports the natural movement of the user's hands and body during operation and maintenance tasks.	0.437	3.76	Strongly Agree
3.	The product dimensions are proportioned to fit the intended space and usage setup, providing easy handling and access.	0.514	3.53	Strongly Agree
4.	The product enables users to operate efficiently and safely, minimizing strain or awkward movements.	0.507	3.59	Strongly Agree
5.	The product design helps users streamline tasks such as egg loading, temperature checking, or cleaning.	0.493	3.35	Strongly Agree
6.	The initial setup process of the product is straightforward and does not require complex procedures or tools.	0.507	3.59	Strongly Agree
7.	The product's control mechanisms (e.g., thermostat, breaker, inverter) are intuitive and positioned for user-friendly access.	0.507	3.59	Strongly Agree
8.	The product includes clear indicators or labelling that guide the user through proper operation and troubleshooting.	0.507	3.59	Strongly Agree
9.	The product's overall weight and form factor allow for easy relocation without requiring excessive force.	0.437	3.76	Strongly Agree
10.	The product's ergonomic design ensures comfort and convenience during regular use, even over extended periods.	0.493	3.65	Strongly Agree
	Overall Mean	0.03	3.61	Strongly Agree

Legend: Strongly Disagree 1.00–1.75, Disagree 1.75–2.50, Agree 2.51–3.25, Strongly Agree 3.26–4.0.

The implications of these findings highlight the product's adaptability and ease of use, making it suitable for a diverse range of users and operational environments. Modularity promotes efficiency during tasks such as loading, cleaning, or adjusting settings, and encourages user independence by simplifying troubleshooting and maintenance. Its ergonomic and portable nature supports flexibility in educational or small-scale industrial applications, making it ideal for classroom demonstrations, skill development workshops, or localized production. Furthermore, the modular approach facilitates replicability, customization, and scalability, providing a strong foundation for future design iterations or mass production.

Table 6 presents the experts' evaluation of the product's ergonomics, with an overall mean of 3.63 and a standard deviation of 0.02, interpreted as Strongly Agree. The evaluation

indicates that the product is ergonomically designed to accommodate the user's body dimensions, promoting comfort, safety, and ease of use.

Table 6. Experts' Evaluation of Product Development in Terms of Ergonomics.

	Statement	Standard Deviation	Mean	Verbal Interpretation
1.	The product is designed with an appropriate length and width that suits the user's body and intended use.	0.470	3.71	Strongly Agree
2.	The height and positioning of the holder support good posture and a safe working stance.	0.507	3.59	Strongly Agree
3.	The product allows comfortable and natural movement of the user's arms, wrists, and hands.	0.493	3.65	Strongly Agree
4.	The grip or handle of the holder feels natural, secure, and easy to hold.	0.493	3.65	Strongly Agree
5.	The layout of the components supports smooth and uninterrupted movement during operation.	0.507	3.59	Strongly Agree
6.	The height and positioning of the holder promote good posture.	0.470	3.71	Strongly Agree
7.	The height and positioning of the holder promote good posture.	0.470	3.71	Strongly Agree
8.	The holder does not block the user's view while working.	0.507	3.41	Strongly Agree
9.	The surface of the holder is smooth and free from features that cause skin irritation.	0.493	3.65	Strongly Agree
10.	The spacing and arrangement of components prevent accidental hand collision during work.	0.507	3.59	Strongly Agree
	Overall Mean	0.02	3.63	Strongly Agree

Legend: Strongly Disagree 1.00–1.75, Disagree 1.75–2.50, Agree 2.51–3.25, Strongly Agree 3.26–4.0.

Experts strongly agreed that the product features appropriate length and width (Mean = 3.71), allows for natural arm and hand movement (Mean = 3.65), provides a comfortable and secure grip, and supports good posture through proper height and positioning. Additional features such as a smooth surface, clear visibility during use, and well-spaced components contribute to safe and efficient operation. These findings suggest that the product can be used for extended periods without discomfort, making it an ideal choice for technical training and practical applications. Its ergonomic reliability not only enhances user productivity and satisfaction but also minimizes physical strain and the risk of injury, ensuring effective and sustained use in both educational and operational settings.

4. Conclusions

The study successfully developed a combined egg-and-hatchery incubator. The design successfully integrated both incubation and hatching functionalities into a single, compact system, emphasizing user convenience and operational efficiency. By incorporating features such as appropriate ventilation, temperature control, and accessible compartments, the design ensured optimal conditions for egg development. Expert validation from professionals in agricultural technology and poultry production confirmed the design's relevance, safety, and functional accuracy. The developed prototype, based on the validated design, effectively utilized durable, locally sourced materials, promoting both sustainability and

cost efficiency. Its dual-compartment structure, transparent viewing window, integrated temperature and humidity control systems, and easy-access tray system facilitate practical handling of eggs. The fabrication process confirmed the unit's structural soundness and practicality, resulting in a fully functional product capable of performing both incubation and hatching tasks effectively. Moreover, expert evaluations revealed that the developed combination egg incubator and hatchery performs highly effectively across all assessed criteria. Receiving very satisfactory ratings in design, construction, availability, functionality, usability, aesthetic appeal, modularity, and ergonomics, the product stood out for its ease of operation, maintainability, and visual appeal. Its modular features enabled easy component replacement and upgrading, making it well-suited for small-scale poultry farming and academic demonstrations.

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Informed Consent Statement: Letters with participants' consent were included during data collection. Answering the surveys was purely optional or voluntary. Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available upon the request from the corresponding author at mmfaulve@csucc.edu.ph.

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Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Van Wageningen, N.; Meinderts, J.; Bonnier, P.; Kasper, H. *Hatching Eggs by Hens or in an Incubator*; Agromisa Foundation: Wageningen, The Netherlands, 2004.
2. Levi-Mourao, A.; Madeira, F.; Meseguer, R.; García, A.; Pons, X. Effects of temperature and relative humidity on the embryonic development of *Hypera postica* Gyllenhal (Col.: Curculionidae). *Insects* **2021**, *12*, 250. [CrossRef]
3. Berghaus, R.D.; Thayer, S.G.; Law, B.F.; Mild, R.M.; Hofacre, C.L.; Singer, R.S. Enumeration of *Salmonella* and *Campylobacter* spp. in environmental farm samples and processing plant carcass rinses from commercial broiler chicken flocks. *Appl. Environ. Microbiol.* **2013**, *79*, 4106–4114. [CrossRef] [PubMed]
4. Aviagen. Ross Broiler Management Handbook. Available online: https://aviagen.com/assets/Tech_Center/Ross_Broiler/Aviagen-ROSS-Broiler-Handbook-EN.pdf (accessed on 16 November 2025).
5. Mississippi State University Extension Service. Pipped Eggs That Do Not Hatch. Available online: https://extension.msstate.edu/agriculture/livestock/poultry/pipped-eggs-do-not-hatch (accessed on 16 November 2025).
6. Seels, B.B.; Richey, R.C. *Instructional Technology: The Definition and Domains of the Field*; AECT: Washington, DC, USA, 1994.

7. Josefsson, T.A.; Thuvander, L. Form follows availability: The reuse revolution. *IOP Conf. Ser. Earth Environ. Sci.* **2020**, *588*, 042037. [CrossRef]
8. Bocharov, A.; Gordeeva, T.; Didkovskaya, O. Practical application of expert methods for assessing the influence of structural materials on the durability of a critical structure. *Econ. Leg. Found. Gov.* **2024**, *1*, 48–55. [CrossRef]
9. Villa, D.K.; Melo, E.C.; Nicacio, J.V.; Pizziolo, T. Automated air conditioning system for agricultural product drying and storage. *Eng. Agric.* **2023**, *43*, e20210103. [CrossRef]
10. Paes, J.; Ramos, V.A.; Oliveira, M.V.M.D.; Pinto, M.F.; Lovisi, T.A.P.; Souza, W.D. Automation of monitoring of drying parameters in hybrid solar-electric dryer for agricultural products. *Rev. Bras. Eng. Agric. Ambient.* **2022**, *26*, 283–291. [CrossRef]
11. Kim, S.K.; Lee, Y.; Yoon, H.; Choi, J. Adaptation of extended reality smart glasses for core nursing skill training among undergraduate nursing students: Usability and feasibility study. *J. Med. Internet Res.* **2021**, *23*, e24313. [CrossRef] [PubMed]
12. Sembiring, M.A.R.; Sinaga, D.H.; Sinurya, A.; Waluyo, B.; Manullang, J.; Lubis, R.A.A.; Tampubolon, R.N. Development of a programmable logic control trainer as an industrial automation learning tool. In Proceedings of the 6th International Conference on Innovation in Education, Science, and Culture (ICIESC), Medan, Indonesia, 17 September 2024. [CrossRef]
13. David, B.G. The role of aesthetics in medical device design. *Res. Invent. J. Biol. Appl. Sci.* **2024**, *4*, 26–30. [CrossRef]
14. Egan, A. Understanding aesthetics in design education. In Proceedings of the 23rd International Conference on Engineering and Product Design Education (E&PDE 2021), Herning, Denmark, 9–10 September 2021. [CrossRef]

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