

Design and Development of Battery-Operated Jot Attache Case Kit (BOJACK)

Billie Jack DR. Pasion¹, Marites M. Cumbe², Rodelyn T. Vertudazo³

^{1, 2, 3}College of Industrial Technology, Nueva Ecija University of Science and Technology, Cabanatuan City, Nueva Ecija, Philippines

Abstract— This study aimed to design and develop a Battery-Operated Jot Attache Case Kit (BOJACK). Further, it was assessed by two group of respondents on its technical characteristics. Developmental research design was utilized and the concept of the ADDIE model was employed in this study. The research results are synopsised as follows: 1. the development phase of BOJACK goes through analyzation, designing which entails the draft plan, materials and costing, and the actual construction using the appropriate tools and equipment; and 2. the two groups of respondents assessed the technical characteristics of BOJACK based on the criterion described in ISO 9126 standards like functionality, reliability, usability, efficiency, maintainability and portability. The respondent's approval qualifies the developed draftsman kit to utilized in drafting technology and other allied courses.

Keywords— Attache case; Battery-operated; Compact design; Drafting technology; Draftsman kit.

I. INTRODUCTION

Industrial research is one of the categories of research and development which refers to intentional study or careful inquiry with the purpose of learning new information and abilities. Industrial research as defined, this should be the purpose of product development, processes or services that lead to an improvement in existing products, processes or services [1]. The importance of research to an academic institution's viability and expansion in a globalised environment makes knowledge-driven growth based on innovation essential. The fundamental goal of research is to gain knowledge. The kids, community, and nation all gain from high-quality research since it directly correlates with effective classroom instruction. The promotion of research in a huge and diverse country like India will help the nation evolve as a knowledge reservoir in the international arena [2].

The educational sector of the Philippines covers the basic education, higher education and technical-vocational (Tec-Voc) education. These three governing bodies in the academe has a common program in terms of drafting technology. A curriculum in drafting technology focuses on the subject of drafting and, in particular, stresses the fundamentals of hand-drafting, including drawing, lettering, and the use of drafting instruments. In the basic education, technical drafting was being offered in grade 10 under the Technology-Livelihood Education (TLE) specialization while in the Tec-Voc education; it is a Technical Education and Skills Development Authority (TESDA) course that includes the competences one needs to master in order to create architectural layout and detail drawings using both Computer-Aided Design (CAD) software and manual drafting techniques. On the other hand,

in higher education, drafting technology is integrated in Industrial Technology, Architecture and Engineering courses. No matter what level of education it is, drafting technology utilized a common drafting tool that is required in all drafting laboratories and work-shops which is the drafting table. In the industrial sector, drafting tables are also utilized by draftsman, architects and engineers in their respective works. Commercial drafting tables nowadays are too bulky in nature which requires larger space, heavy and costly with limited functionality.

It is in this juncture that the researchers designed and developed an instructional device which is handy and rechargeable drafting board. It is a drafting instrument enclosed in a wooden attache case that can serve as a substitute to traditional drafting table. This innovation is can be utilized in the academe particularly by the drafting technology, architecture and engineering students. If given the chance to be commercialized, draftsman, architects and engineers will also benefit in this particular niche. Studies have proven that academic research has greatly contributed to efficiencies and productivity among various industries [3].

II. LITERATURE REVIEW

Innovation is the process of enhancing an existing concept or product with fresh knowledge and ideas while also significantly altering society [4].

A. Importance of Product Design and Development

The procedures of design and development should scrutinize the entire possible obstacle that might need to trounce by the innovators to get their innovations in the market. The importance of design and development plays a major role in the success of the product or process. The intended design must be implemented during the development of the product or process. The success of a new product typically requires considerable resources and the likelihood for lackluster results or outright failure is far higher than anyone will admit. Moreover, all successful product development actions provide the following; new value for customers, improved society and continued existence of the company [5]. The relevant motivation to conduct innovation for novel development is to offer new value to the client. On the other hand, successful products which sell on the market are defined by clever product design – especially now that consumers have even more power when it comes to recommending a product and being advocates on social media [6].

B. Innovation in the Academe

Innovation is the application of ideas in a real-world setting that leads to the creation of new products or services or to an improvement in the provision of existing ones. However, innovation in the academe is usually performed by educators, learners or combination of both. In higher education institutions, academic innovation is a growingly integrated effort and topic of focus. Numerous focuses, such as teaching and learning research, faculty development programming, and entrepreneurial components are frequently included in academic innovation units [7]. Forays into innovative areas such as adaptive learning, pedagogical partnerships, technology enhancements, and multimodal learning often aspire to create successful responses to evolving learning environments [8], hence, innovation in education can lead to better overall outcomes in the school environment [9].

C. Technological Innovation and Transfer

A technological innovation is a new or improved product or process whose technological characteristics are significantly different from before [10]. Technological innovations can be transferred formally or informally between academic institutions, corporations, and governments in order to exchange expertise, knowledge, technologies, production processes, etc... This method of knowledge sharing ensures that scientific and technological innovations are accessible to more users, who can then contribute to their growth or utilization. Thus, Technology transfer is the movement of data, designs, inventions, materials, software, technical knowledge or trade secrets from one organization to another or from one purpose to another [11]. The rules, methods, and values of each organization involved in the process serve as a guide for the technology transfer process. Technology transfer is the process by which basic scientific discoveries and inventions are developed and transformed into practical and commercially relevant innovations, that reach the market and benefit society [12].

D. Relevance of the Literature Reviewed in the Current Study

The literature reviewed in this part provided the researchers with insights on the need for the design and development of BOJACK: the developed instructional device is an alternative drafting table for drafting technology and other allied courses. The body of writing mentioned by the researchers enabled them to sift through the ideas reviewed such that they were able to concretize their concepts in the design of the developed instructional device which is the focus of their study.

III. METHODOLOGY

The developmental research design was used in this study. Developmental research, as opposed to simple instructional development, has been 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" [13].

Forty-five (45) respondents assessed BOJACK. The distribution was as follows: ten (10) drafting technology

students, ten (10) architecture students, ten (10) engineering students, five (5) drafting technology teachers, five (5) architects and five (5) engineers in the Colleges of Industrial Technology, Architecture and Engineering of Nueva Ecija University of Science and Technology (NEUST), Cabanatuan City, Nueva Ecija, Philippines.

The research's critics assessed the instrument's content validity. Through many gatherings and conversations, the survey items' validity and reliability were confirmed. Respondents completed questions to help assess the main instrument's content.

The reliability coefficient was calculated using Cronbach's Alpha to assess the item's internal consistency. The test's reliability is demonstrated by the fact that both the first and second times it was administered, the results were both 0.81 and scored as moderately high.

IV. RESULTS AND DISCUSSION

This study utilized the ADDIE model concept to design and develop the Battery-Operated Jot Attache Case Kit.

A. Development of the Battery-Operated Jot Attache Case Kit (BOJACK) based on ADDIE model

The development of BOJACK followed the five phases of the ADDIE model such as Analyze, Design, Development, Implement and Evaluate. The first phase of development depicted the analyzation of the current situation of drafting tables, while the second phase illustrated the design of BOJACK which entails the draft plan, materials and costing. On the other hand, the third phase is the actual development of BOJACK and the fourth phase is the actual deployment of BOJACK into its projected learning environment. Finally, the last phase is the authentic assessment of the respondents on the technical characteristics of BOJACK.

Analysis Phase. It is in this phase that the researchers scrutinize the current features of a traditional drafting table used in the College of Industrial Technology, College of Engineering and College of Architecture of NEUST. It is natural that the size of drafting table is bulky and quite spacious in nature, and aside from that it is pricey. This is quite an issue for the researchers that needs to be address.

Design Phase. According on the findings in the analysis phase, the researchers came up with the idea to design an instructional material as an alternative to customary drafting tables. BOJACK's design and technical features includes: handy, rechargeable, trendy, and compact with built-in drafting tools compartment. The materials used and its costing is shown in the table below.

TABLE I. Total costing of BOJACK's Materials.

Materials	Quantity	Unit	Price
0.5mm Acrylic Glass (17"x12")	1	pc	400.00
700mAh Lead-acid battery	1	pc	100.00
1.5W LED	1	set	60.00
½" x ½" x 10" Liston	2	pc	160.00
Lock Magnet	1	set	60.00
1 ½" Butt Hinge	2	pcs	30.00
Cabinet Handle	1	pc	30.00
½" Wood Nail	1/16	kg	10.00
Total			₱850.00

Table I shows the total costing of the developed product is ₱850.00, this indicates that is cheaper than the current price of commercial drafting table. Other material used is plywood. It was not included in the costing because this is a recycled material used by the researchers. The following figures shown below is the two-dimensional and three-dimensional design of the developed battery-operated jot attache case kit drawn using CAD system.

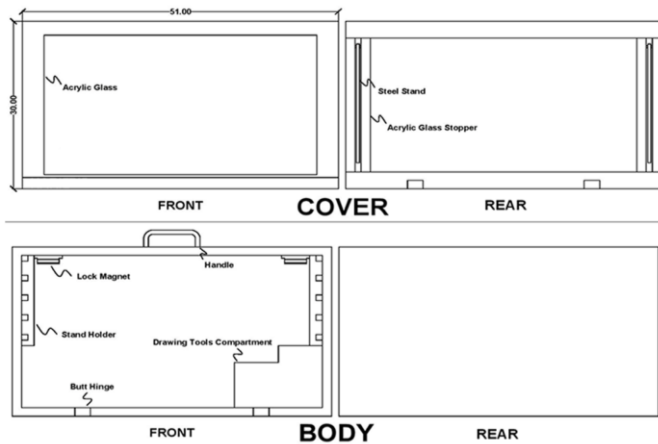


Fig. 1. Two-dimensional draft plan of BOJACK

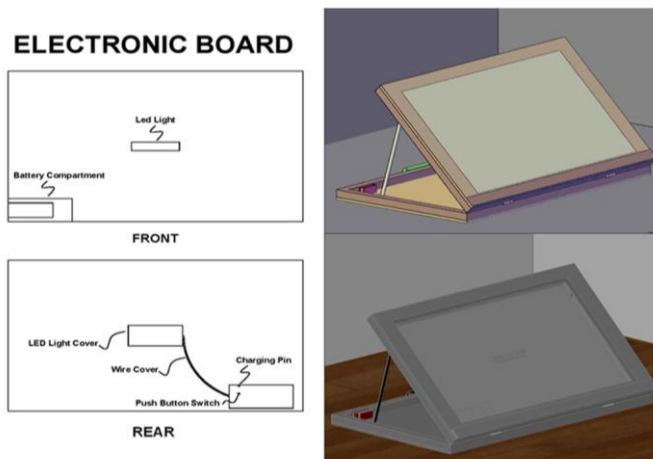


Fig. 2. Three-dimensional design of BOJACK

Development Phase. The development phase is the actual construction of BOJACK based on its conceptualized design and intended materials. The table below shows the Gantt chart of development of the product developed.

As shown in the table, BOJACK’s activity of development is finished within five days. Usually, the researchers developed the product during their spare time, so that they can perform their specific task assigned to them. However, if a specialized or skilled person did the development process of BOJACK, possibly it can be finished within two (2) to three (3) days only.

The development process of the developed product started when the researchers bought the necessary materials needed during its creation. The preparation of the tools and equipment is also part of it. Other processes are measuring, cutting, drilling, polishing, grinding, attaching, assembling, affixing

and installing the materials. Lastly, the testing of BOJACK was being performed to examine the intended functionalities are working properly. The following figure shows some of the of the processes performed by one of the researchers.

TABLE II. BOJACK’s Gantt Chart of Development

Activity	Duration (Day)				
	1	2	3	4	5
Purchasing of materials and preparing of hand tools and equipment.	█				
Measuring, cutting and polishing of plywood and liston.	█	█			
Constructing and painting of BOJACK’s body and cover. Cutting, drilling and attaching the steel stand.		█	█		
Combining BOJACK’s body and cover together. Constructing the drafting tools compartment and the stand holder. Affixing the acrylic glass, lock magnet, butt hinge and handle.			█	█	
Assembling and attaching BOJACK’s electronic components. Testing the functionalities.				█	█



Fig. 3. Cutting, Polishing, Grinding and Drilling of BOJACK’s Materials



Fig. 4. Painting, Attaching, Assembling and Installing of BOJACK’s Materials

Implementation Phase. In this phase, the researcher’s BOJACK features was tested very carefully before its

deployment into its designated learning environment. Further, it was used by the student and teacher respondents to test its functionalities. The figure below shows that the developed kit was being tested.



Fig. 5. BOJACK's Features was Being Tested

Evaluation Phase. After its enactment, BOJACK industrial features was assessed in this phase. Some of the respondents utilized the tangible research instruments, while others preferred to use the Google form made by the researchers.

B. Assessment of the Battery-Operated Jot Attche Case Kit (BOJACK) based on ISO 9126 Standards

The group of respondents were asked to assess the technical characteristics of BOJACK based on the ISO 9126 standards such as functionality, reliability, usability, efficiency, maintainability and portability. The table below show the summary of assessment of the student and teacher respondents.

TABLE III. Summary of BOJACK's Technical Characteristics.

Descriptors	Weighted Mean	Verbal Interpretation
Functionality	3.83	Very Functional
Reliability	3.68	Very Reliable
Usability	3.73	Very Usable
Efficiency	3.69	Very Efficient
Maintainability	3.71	Very Maintainable
Portability	3.92	Very Portable
Overall Weighted Mean	3.76	

As shown in the table, the overall weighted mean of 3.76 signifies that the respondents agreed that BOJACK's technical characteristics was successfully performed its functionalities, it is a trustworthy drafting equipment, it is very practical and operational, it is effective like the traditional drafting table, it is easy to maintain and it is very handy.

V. CONCLUSIONS AND RECOMMENDATIONS

The Battery-Operated Jot Attache Case Kit was developed using the phases of the ADDIE model successfully by

following its intended draft plan and materials. BOJACK's technical characteristics based on ISO 9126 standards such as functionality, reliability, usability, efficiency, maintainability and portability were assessed by two (2) groups of respondents, namely: students and teachers from NEUST's College of Industrial Technology, Architecture and Engineering.

Based on the conclusions above, the following recommendations was offered. For further research, replace the transparent acrylic glass with white acrylic sheet board, use Lithium-ion batteries instead of Lead-acid batteries and add more LED to increase the brightness.

REFERENCES

- [1] Categories of research and development. (n.d.). Retrieved September 14, 2022, from <https://www.ukri.org/councils/innovate-uk/guidance-for-applicants/general-guidance/categories-of-research-and-development/>
- [2] Das, J. K. (2017, March 12). Role of research in an academic institution is significant, here's why. Financial Express. Retrieved September 14, 2022, from <https://www.financialexpress.com/jobs/role-of-research-in-an-academic-institution-is-significant-heres-why/586210/>
- [3] Degani, Gad & Levanon, Dan & Yom Din, Gregory. (2021). Socioeconomic Impact of Academic Research and Higher Education on Peripheral Development: The Case of Israel. 10.20944/preprints202107.0591.v1.
- [4] Roberto R. Santiago, Billie Jack DR. Pasion, Tranquilino J. Lucas, Jovenon I. Lacanilao, & Ronnie O. Juliano. (2022). Construction and Evaluation of Arduino-based with Real-time Notification Anti-Carnapping (ARNAC) Device. *International Journal of Progressive Research in Science and Engineering*, 3(09), 76–83. Retrieved from <https://journals.grdpublications.com/index.php/ijprse/article/view/715>
- [5] The Importance of Product Development. (2019, September 3). Higher Logic, LLC. Retrieved September 19, 2022, from <https://connect.informs.org/blogs/james-mellor/2019/09/03/the-importan>
- [6] Ideareality. Design. (2021, February 17). Importance of Product Design and Why Consumers Buy into Products. Product Idea Design and Invention Development, Prototypes, 3D CAD, Patents. Retrieved September 19, 2022, from <https://www.ideareality.design/2018/01/25/importance-of-product-design/>
- [7] Barger, A.P., Leffel, K.G. & Lott, M. Plotting Academic Innovation: A Content Analysis of Twenty Institutional Websites. *Innov High Educ* 47, 95–111 (2022). <https://doi.org/10.1007/s10755-021-09568-4>
- [8] Blumenstyk, G. & Gardner, L. (2019). Innovation imperative: The buzz, the barriers, and what real change looks like. *The Chronicle of Higher Education*.
- [9] McMillan, A. C. (2021, July 15). The Impact of Innovation in Education. Graduate Programs for Educators. Retrieved September 24, 2022, from <https://www.graduateprogram.org/2021/07/the-impact-of-innovation-in-education/>
- [10] Technological innovation | Concepts | Statistics Finland. (n.d.-b). Retrieved September 23, 2022, from https://www.stat.fi/meta/kas/tekn_innovaatio_en.html
- [11] What is Technology Transfer? (Definition and Examples). (n.d.). TWI. Retrieved September 23, 2022, from <https://www.twi-global.com/technical-knowledge/faqs/what-is-technology-transfer>
- [12] Why technology transfer leads to innovation success. (n.d.). IAM. Retrieved September 23, 2022, from <https://www.iam-media.com/article/why-technology-transfer-leads-innovation-success>
- [13] Richey, R. C., Klein, J. D., & Nelson, W. A. (2004). Developmental Research: Studies of Instructional Design and Development. In D. H. Jonassen (Ed.), *Handbook of research on educational communications and technology* (pp. 1099–1130). Lawrence Erlbaum Associates Publishers.