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Design and Analysis of Smart Laptop Table Production with an Ergonomic Approach and Minimalist Design

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Abstract

This study focuses on the design and development of a smart ergonomic laptop table with a modern and minimalist aesthetic to enhance user comfort and prevent musculoskeletal disorders during prolonged laptop use. Using the Stanford Design Thinking methodology, the research was conducted through six stages: empathize, define, ideate, prototype, test, and assessment. Data were collected from 26 respondents through surveys and interviews to identify key user needs, including adjustable height and tilt, integrated cooling pad, power socket, and portability. The prototype, constructed from Dutch teak wood and a hollow iron frame, was analyzed through stress, displacement, and strain simulations to ensure structural reliability and durability. The results demonstrated that the final design effectively supports ergonomic posture, reduces discomfort in the neck, back, shoulders, and wrists, and prevents repetitive strain injuries. Additionally, the product combines functional efficiency with an appealing minimalist appearance suitable for modern workspaces. The proposed design not only improves user well-being and productivity but also contributes to sustainable and space-efficient furniture innovation.

1. INTRODUCTION

The phenomenon of multifunctional furniture has become increasingly popular among millennials. Such furniture is designed to optimize space utilization while offering high flexibility through modular design. This modular characteristic serves as a key advantage, enabling the integration of multiple functions into a single, efficient product that adapts to limited living spaces. This trend reflects the modern lifestyle's growing demand for efficiency and mobility in daily activities.

Moreover, the increasing use of laptops among students and young professionals presents new ergonomic challenges. Although high-performance laptops with advanced specifications are widely available, their designs often feature inadequate ventilation systems, leading to frequent overheating. Many users, particularly students living in dormitories or small rooms, lack proper desks and are forced to work on the floor, which can result in poor posture, musculoskeletal discomfort, eye strain, and wrist pain. Therefore, it is essential to develop an ergonomic desk design that provides long-term comfort, conserves space, and incorporates multifunctional features to enhance both usability and user well-being during laptop use.

In response to these issues, product innovation in furniture design has increasingly emphasized ergonomics as a central consideration. Ergonomic design aims to adapt products to the physical and cognitive characteristics of users, ensuring comfort, safety, and efficiency during prolonged activities. By integrating ergonomic principles with modern minimalist aesthetics, furniture products can provide both functional and visual benefits. This approach not only supports users' physical health by reducing strain and fatigue but also aligns with contemporary preferences for simple, space-saving, and aesthetically pleasing designs. Consequently, the development of a smart ergonomic laptop table

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represents an essential step toward creating adaptive work environments that meet the demands of modern users in limited spaces.

2. LITERATURE REVIEW

Numerous studies have demonstrated that prolonged laptop use significantly affects user health, particularly in relation to posture, musculoskeletal complaints, and eye strain. Oh, Lee, and Chee (2020) found that laptop stands can reduce neck flexion angles, thereby improving posture, while Wardani *et al*. (2021) emphasized the importance of lightweight, foldable, and height-adjustable stands to support user mobility. Puspitasari (2019) reported that more than half of respondents experienced musculoskeletal discomfort due to non-ergonomic laptop use, and Dockrell *et al*. (2015) further noted that usage duration and individual factors exacerbate such risks.

Additional research reinforces the importance of ergonomic adjustments to laptop equipment. Yadegaripour *et al*. (2020) showed that proper screen and keyboard height adjustments reduce neck and muscle strain, whereas Jain *et al*. (2019) highlighted the risk of shoulder slouching among office workers. Nwuogua and Ezeoke (2018) recommended reclining chairs to minimize discomfort, and Jovanović and Šimunič (2017) demonstrated that ergonomic armrests reduce the likelihood of carpal tunnel syndrome. From a design perspective, Januardi (2020) emphasized that an ideal stand should be comfortable, flexible, and practical; Jafarvand *et al*. (2021) stressed the importance of adapting product dimensions to users' anthropometric data; and Kumar *et al*. (2019) demonstrated that the Quality Function Deployment (QFD) method effectively enhances product quality while minimizing production costs. Overall, these studies highlight that ergonomic laptop stand or desk designs not only mitigate health risks but also improve user comfort, efficiency, and productivity in modern minimalist workstation design.

3. RESEARCH METHOD

This study uses the stanford design thinking and flowchart as well as the success indicators of the research can be seen in Figure 1. This research will be completed through six main stages.

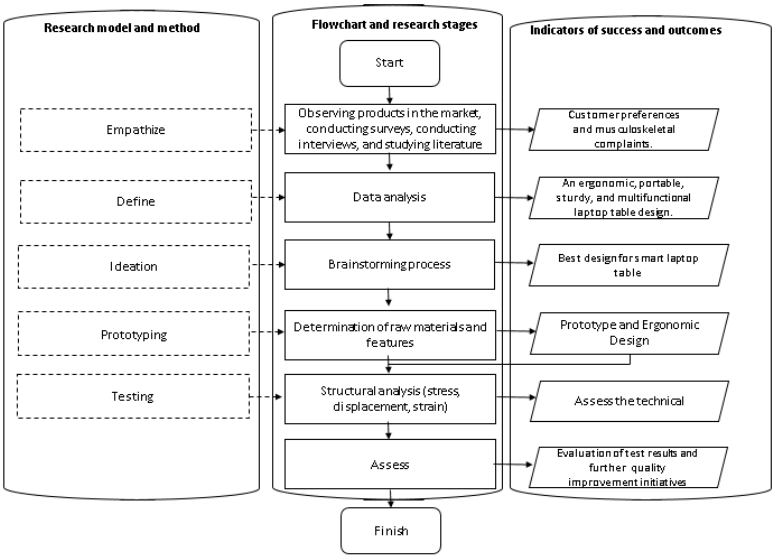

Figure 1.
Research stages

The following are the steps in the design and analysis of smart laptop table production with an ergonomic approach and minimalist design.

1. Empathize – conducted product observation in the market, surveyed 26 respondents (student and worker), conducted interviews, and studied literature related to ergonomics and musculoskeletal complaints.
2. Define – data analysis was used to formulate the main requirements, namely an ergonomic, portable, sturdy, and multifunctional laptop table.
3. Ideation – brainstorming process, followed by house of quality, screening matrix, and scoring matrix to select the best design.
4. Prototyping – prototype made of Dutch teak wood and hollow iron frame, equipped with cooling pad, USB power outlet, wheels, LED lights, and mouse pad.
5. Testing – structural analysis (stress, displacement, strain) conducted to assess the technical and financial feasibility of the product.
6. Assess – Evaluation of test results, identification of strengths and weaknesses, and recommendations for improvement.

4. RESULTS AND DISCUSSION

4.1 Empathize

At this stage, observations and feasibility studies are conducted on existing products, interviews with users (using forms and direct interviews), interactions, and literature studies.

4.1.1. Observation Results

By observing products that are already on the market and grouping them into three price categories, namely high, medium, and low. Next, an analysis of the advantages and disadvantages of each product is carried out as a reference in project design

(a) High prices (b) Medium prices (c) Low prices

Figure 2.
Multifunctional table on the marketplace

4.1.2. Interview Results

The preliminary survey was done to learn and emphatize the responden needs. Its also included the item of requirement for the expected design from the responden.

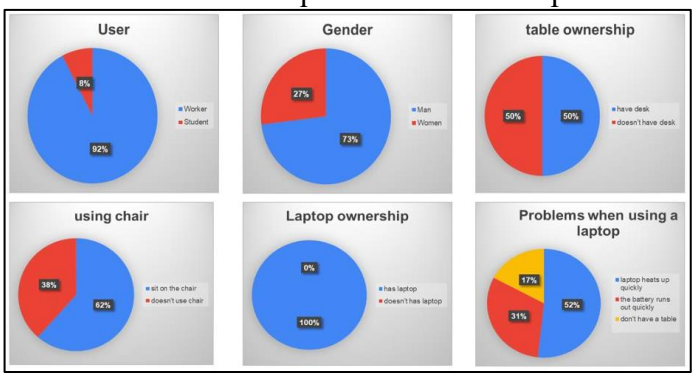

Figure 3.
Stage 1 Interview result

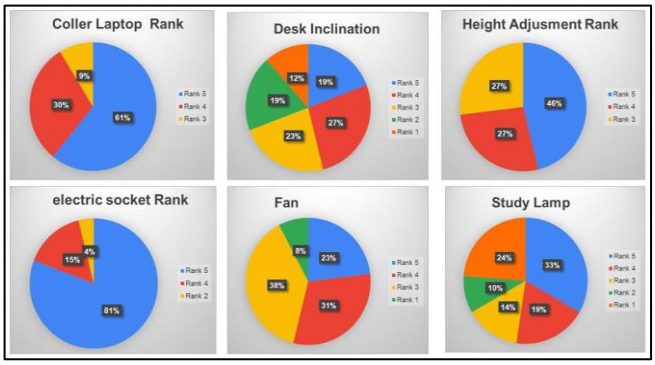

Figure 4.
Stage 1 Interview result

A preliminary survey was conducted to understand and identify the respondents' needs. This survey also included items related to the design requirements expected by the respondents. The survey was conducted on 26 respondents consisting of students and workers. Based on the survey results, the higher the rating of a feature, the more important that feature is. It was found that cooling pads, electrical sockets, and height adjustment were the most important features needed by respondents.

Product development priorities indicate that the product must have several essential features, especially those related to durability, portability, and ergonomic adjustability. Recent ergonomic studies show that adjustable height and angle are crucial in reducing musculoskeletal discomfort and improving posture during laptop use (Kim & Park, 2022). In addition, cooling features such as a built-in cooling pad are increasingly important, as they help reduce laptop temperature and maintain performance during long periods of use (Rahman & Islam, 2023). These findings support the inclusion of durability, lightweight materials, portability, cooling capability, electric sockets, and adjustable ergonomic features as the core requirements for designing an ergonomic laptop table. In this study, Product development priorities indicate that the product must have the following features:

1. Durable
   Durability is a must because it will ensure that the product is not easily damaged.
2. Lightweight
   Since this table is expected to be moved to various places, it is expected to be lightweight.
3. Portable
   The table must be movable because this is one of its main attractive features.
4. Cooling Pad
   The cooling pad will help laptop air circulation and minimize the risk of overheating. This is one of the main features desired by respondents based on the survey.
5. Electric Socket
   An electric socket will provide charging capabilities, so users do not need to look for electrical outlets elsewhere. This is one of the main features desired by respondents based on the survey.
6. Adjustable Height and Angle
   Adjustable height and angle will provide ergonomic value and minimize musculoskeletal disorders. The table itself will be designed as an ergonomic product.

Based on Table 1 a summary of the percentage ratings for smart laptop table features is shown based on the results of a survey that was conducted previously.

Table 1.
Recap of laptop desk feature assessment percentages

No	Feature	**Percentage (%)**
1	**Electric socket**	**81%**
2	*Cooli**ng*** **pad**	**61%**
3	**Height adju*stm*ent**	**46%**
4	*Study lamp*	**33%**
5	*Desk inclination*	**27%**
6	*Fan*	**23%**

Based on the feature ranking results for laptop desks, According to respondents, cooling pads, electrical sockets, and height adjustment are the most urgent features. To gain deeper insights into user needs and experiences, direct interviews were conducted with several consumers. The findings revealed that most respondents experienced work discomfort due to the use of non-ergonomic desks. The first respondent reported shoulder pain and neck stiffness caused by improper laptop screen positioning. Although the desk used was sturdy and aesthetically pleasing, it was considered lacking in portability. The second respondent also experienced back and neck pain, noting that a portable and ergonomic desk design would add value despite the current desk's strength. The third respondent complained of eye strain and shoulder pain while preparing reports, emphasizing the importance of adjustable laptop height. Meanwhile, the fourth respondent experienced wrist and shoulder pain after working for more than eight hours and highlighted the need for a mouse pad to enhance work comfort.

4.1.3. Literature Study

Various studies show that long-term laptop use affects health, especially posture, musculoskeletal complaints, and eye strain. Oh, Lee, and Chee (2020) proved that laptop stands can reduce neck flexion angles, thereby improving posture, while Wardani *et al*. (2021) emphasized the importance of stands that are lightweight, foldable, and easily adjustable in height to support mobility.

4.2 Define

At define stage, all information obtained from the empathize stage is collected analyzed, to determine the core of the problem to be identified. Based on the conducted observations, literature review, and interviews, it was identified that current working desks or study tables exhibit a wide variety of designs, materials, and price ranges, targeting different market segments. Similarly, existing laptop desks or stands differ in terms of size, material, multifunctionality, and intended purpose. Factors such as table size, adaptability, and user comfort play a significant role in influencing consumer preferences and purchasing decisions. However, interview findings revealed that while most users own laptops, not all of them possess specialized tables designed for work or study activities, indicating a need for additional functional features in such products.

Several issues were identified in relation to existing products. Observations showed that most desks lack adjustable height and tilt mechanisms and do not include supplementary features such as study lamps, cooling pads, or integrated laptop stands. Consequently, laptops tend to overheat quickly during use. The literature review further supports this finding, highlighting that not all laptop desks allow for height or inclination adjustments, thereby requiring users to manually modify their laptop positioning to achieve a comfortable viewing angle. Interview results were consistent with these observations, emphasizing user challenges such as rapid laptop heating, fixed height and tilt angles, and table surfaces

unsuitable for direct mouse use—necessitating a separate mouse pad. Additionally, not all laptop desks are designed to be portable, limiting their convenience and usability.

From a user perspective, the findings consistently indicate that prolonged laptop use often results in discomfort. According to the literature, this discomfort is primarily caused by poor posture resulting from non-ergonomic workspace design, extended usage duration, and improper screen positioning relative to eye level. These factors contribute to musculoskeletal strain and pain in the wrist, neck, waist, back, and shoulders. Overall, the evidence suggests a clear need for improved ergonomic design and functionality in laptop desk products to enhance user comfort and reduce physical strain during long-term use.

After research, interview observation and survey conducted, empathy maps generated to help team brainstorming to explore deeper into users minds and feelings. Emphaty Map is a visualization tool used to articulate what the product team knows about users. This Empathy Map helps product teams to build a broader understanding of the "why" behind user needs and desires (Binus, 2021). Base on analysis result problem statement of this project is "is needed a design of laptop table design that is strong, portable and ergonomic so that it can make users comfortable for long periods of work with a laptop" Main feature plan on our design is build with strong material to ensure safety during using laptop, durable, height and tilt can be adjusted to ensure comfort and ergonomic during using laptop. Because this laptop desk target market is for worker and student for the price medium range (Rp 300.000 - Rp 500.000) to ensure this product affordable for student.

4.3 Ideation

Ideation stage, using several tools to help determine the design to be developed into a prototype. Customer Survey Stage 2 – conducted to obtain more in-depth information about reference features and additional design concepts not obtained in the first stage survey, This is illustrated in the diagrams in Figures 5 and 6.

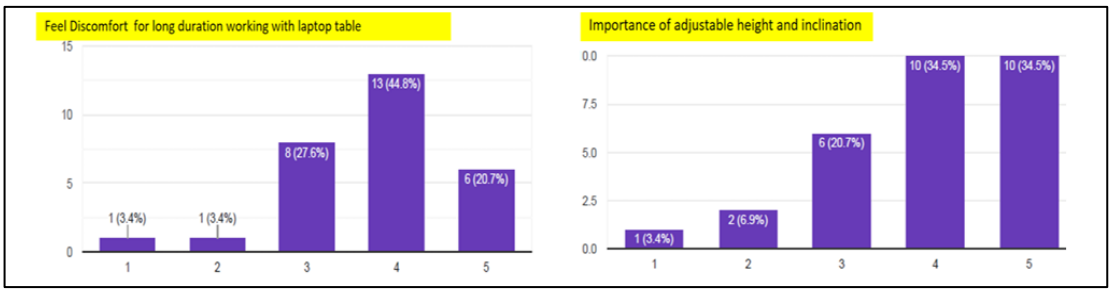

Figure 5.
Survey results related to the comfort of using a laptop for a long duration and the importance of adjustable table height and tilt

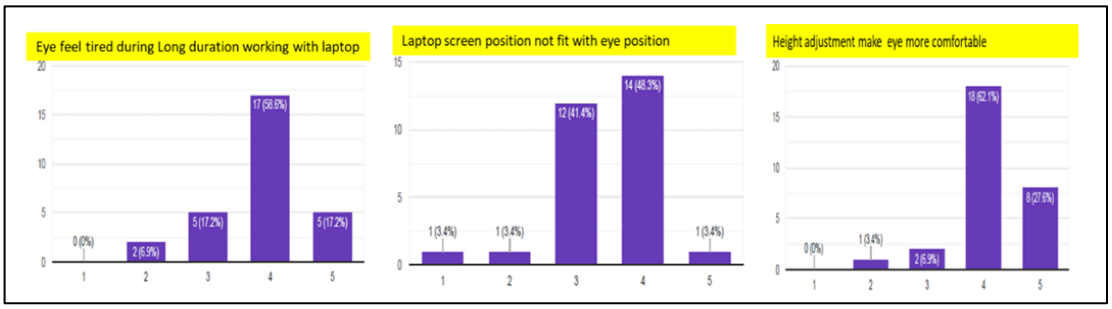

Figure 6.
Survey results related to the customer eye feel discomfort and importance of table height adjustment

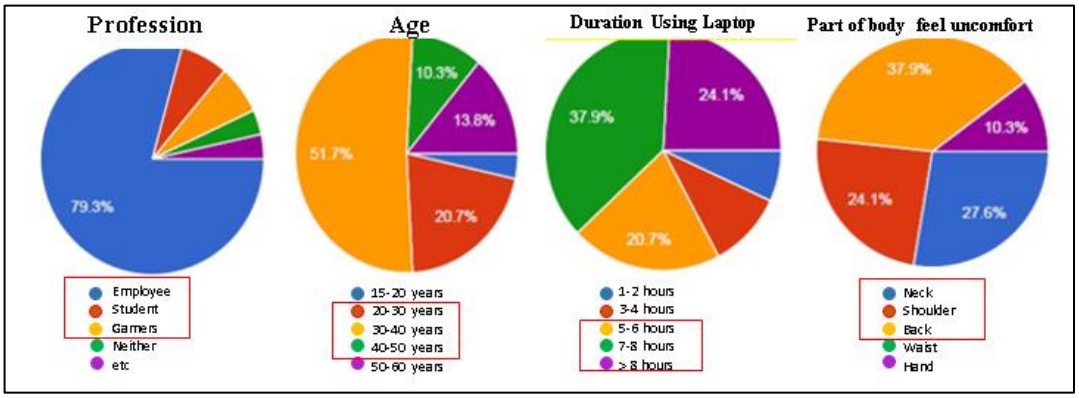

Figure 7.
Survey results related customer

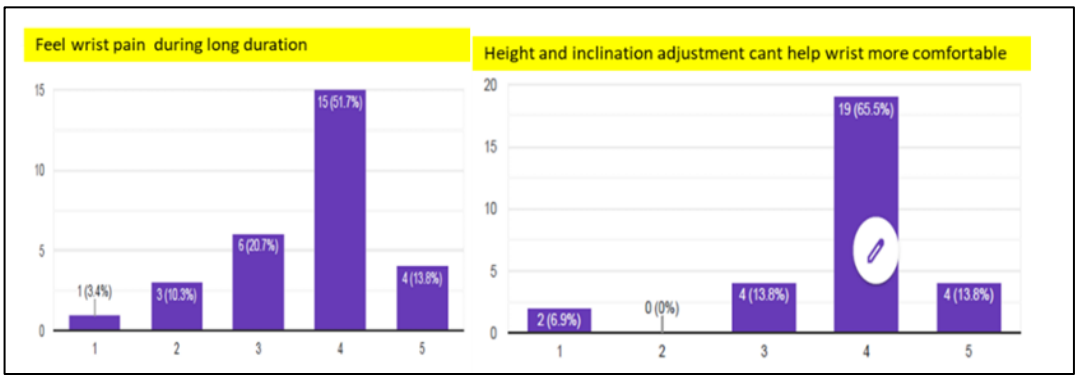

Figure 8.
Survey results related to the customer wrist pain and importance of table

Based on figure 8 the results of the second stage of the survey above, concluded that the features for adjusting the height of the table and the tilt of the table surface can help customers overcome the discomfort of using a laptop on a table for a long time duration.

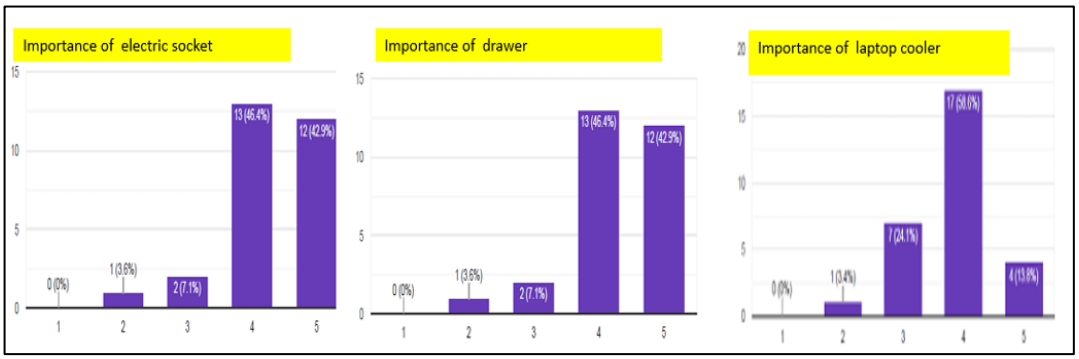

Figure 9.
Survey results related to importance of additional feature

In the second stage of the survey in figure 9, also tried to dig deeper into additional features such as laptop cooling, power sockets and drawers, whether these were also product features that consumers wanted and base on the result these features are wanted by customers.

Figure10.
Survey results related to material dan color

Base on figure 10 result has reference that materials for our product is wood, metal and plastic and the color choices that many customers like are black and white and brown wood. The result of survey is then classified into 8 Dimension of quality, as presented in the table 2. They are the things that make our product stand out from its competitors and give it value. These are the things that differentiate business from others in the marketplace.

Table 2.
Dimension of quality classification

Quality Dimension	Requirements
Performance	Helps and enhances comfort during work or study
Feature	Adjustable height and tilt, Cooling pad, Power socket + USB, High mobility
Reliability	Hinges are easy to adjust and can be securely locked
Aesthetics	Elegant color selection and design
Conformance	Specifications are standardized and follow the Bill of Material
Durability	Durable product materials
Serviceability	User manual provided with the product and Spare parts available on the market

The data from 8-dimension quality will become the part of user requirement for the product. This requirement is compiled and processed by using House of quality. House of Quality is a tool part of quality function deployment that capable of connecting the customer requirement with design step and to compare the design step so the characteristic of the product can be prioritized based on the most important feature (Azhari, 2015). Based on the HOQ 1, it can be concluded that compared to the other competitor product, the designed product is superior in term of requirement in point 3, 4, 5, and 7. This will become the advantage of the designed product that designed to solve the current issue. The functional requirement will then be detailed once more in House of Quality 2. The resulting HOQ is then used as a reference for design process. In this step there are 3 design developed with detail as follow

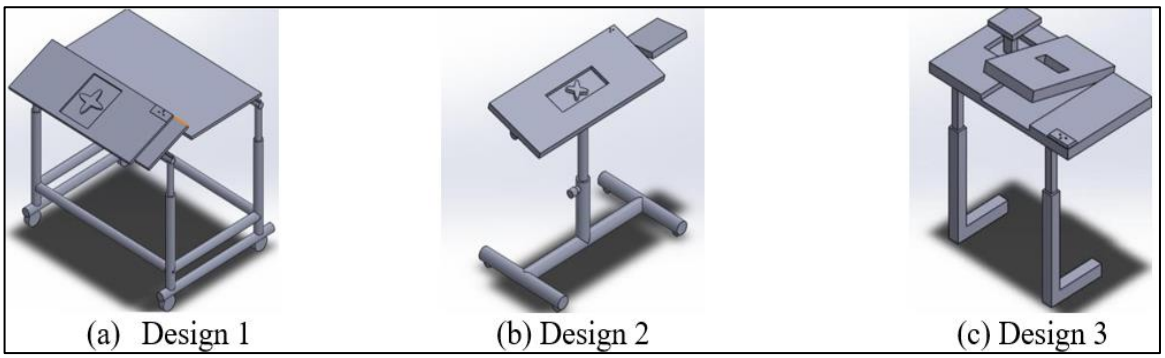

Figure 11.
Three design developed

Base on figure 11 Three design alternatives were developed based on the identified requirements. The features of each design were classified using a Tree Diagram according to several key criteria. These criteria include ergonomic level, adjustability, product features, mobility, material, dimensions, and serviceability. This classification aims to facilitate a systematic evaluation of each design alternative to determine the most optimal solution that meets user needs and functional objectives. The final result concluded that design 1 and 2 is acceptable to the next selection phase. Design 3 is deemed not worthy to proceed due to it is unable to fulfill several requirements including production feature and mobility. Based on the assessment, it is concluded that Design 2 is selected as the final design. Design 1 is not comform because of its large dimension can affect the mobility and make the product heavier. Design 2 is much simpler and more compact so it deemed to have a better mobility capability with lower cost compared to design 1.

4.4. Prototype

This prototype is intended to assist in creating a tangible product from the design with actual features developed during the design phase. The following is the final design of the smart table in Figure 12.

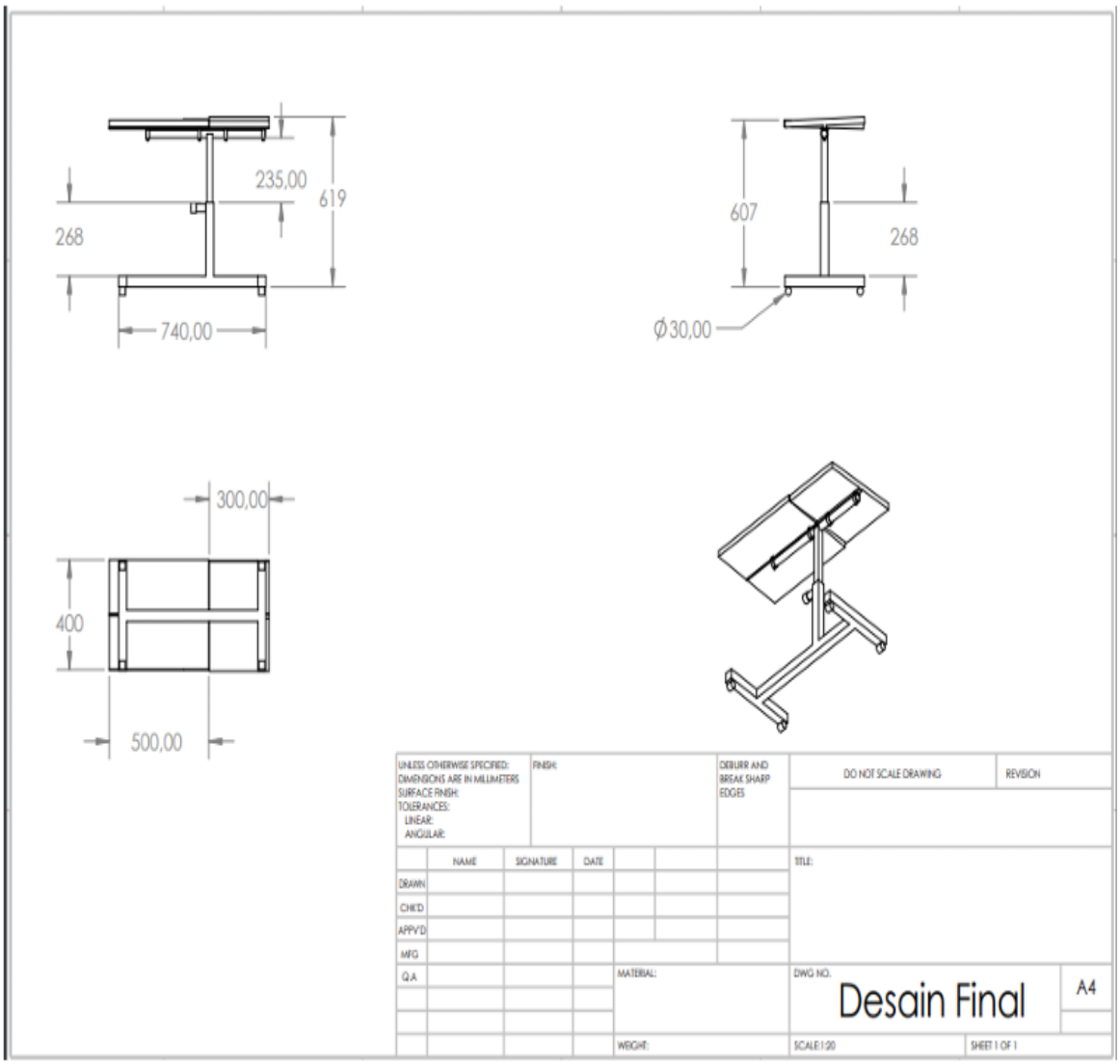

Figure 12.
Final Design

Table 3.
Anthropometric data for Indonesian

No	Dimension	Anthropometric data for indonesian							
		Men				Women			
		P5	P50	P95	SB	P5	P50	P95	SB
1	Body height	162	172	183	5.23	150	159	169	5.76
2	Standing eye height	153	160	172	6.3	139	148	169	5.76
3	Standing shoulder height	134	143	155	6.41	123	132	141	5.91
4	Standing elbow height	99	107	114	5.12	91	99	108	6.4
5	Hip height	83	95	105	6.76	78	88	97	5.91
6	Standing knuckle height	68	75	82	4.75	63	70	78	4.37
7	Standing fingertip height	58	64	71	4.82	54	60	65	3.67
8	Sitting height	80	89	96	5.24	78	83	90	4.7
9	Sitting eye height	69	76	84	4.58	67	73	80	5.83
10	Sitting shoulder height	52	59	67	6.27	51	56	63	4.94
11	Sitting elbow height	19	24	30	4.74	19	25	32	5.19
12	Thigh thickness	12	16	22	3.59	11	15	19	3.22
13	Buttock-popliteal length	48	56	64	4.89	45	53	60	4.81
14	Buttock-knee length	40	46	54	4.82	37	43	51	4.21
15	Knee height	46	54	62	5.21	43	50	60	5.27
16	Popliteal height	38	44	49	3.78	38	44	50	3.92
17	Shoulder breadth (bideltoid)	36	45	52	4.66	37	43	53	5.43
18	Shoulder breadth (biacromial)	31	37	43	4.61	33	38	44	3.56
19	Hip breadth	28	35	43	4.41	29	35	45	7.22
20	Chest breadth/depth	16	21	27	3.5	17	21	28	3.38
21	Abdominal breadth/depth	15	21	29	4.46	14	18	25	3.44
22	Elbow-to-shoulder length	NA	NA	NA	NA	NA	NA	NA	NA
23	Fingertip-to-elbow length	42	47	56	4.55	37	43	50	4.27
24	Arm length (fingertip-to-shoulder)	68	76	84	6.39	62	70	77	4.69
25	Grip-to-shoulder length	56	65	73	6.29	54	60	68	4.3
26	Head length	17	20	24	2.21	15	18	22	3.95
27	Head breadth	15	18	22	2.06	14	17	21	2.48

Source: (Purnomo, 2013)

Anthropometry is defined as the measurement of the human body, so it is hoped that the design made must be based on the size of the human body to be able to increase productivity. In ergonomic product design, anthropometric data are used to determine appropriate dimensions, reach distances, and adjustment ranges that suit the majority of users. By applying anthropometric principles, designers can ensure that the product accommodates variations in human body size, minimizes fatigue, and promotes comfort and efficiency during use. Therefore, incorporating accurate anthropometric data is a critical step in developing furniture that supports both safety and optimal performance in daily activities.

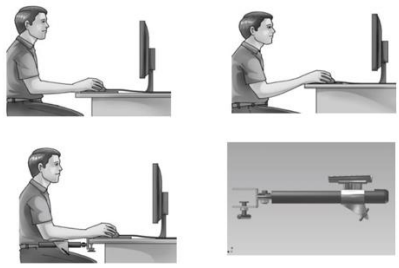

Figure 13.
Work attitude using a mouse and support tools
Source: (Purnomo, 2013)

The above design of furniture cannot be analyzed separately on just one aspects only but must be designed comprehensively. Hand position When using the keyboard, it cannot be separated from the height of the chair can position at elbow height. In this way, the wrist comfort when using the keyboard is not just a consideration just the height of the keyboard but you have to consider the height of the elbows. By looking at Figure 13, the computer station design should at least consider several aspects comprehensively, including hand

position relative to the keyboard, elbow height, popliteal height, backrest angle, hand reach of the monitor, viewing distance, monitors, the angle between the upper and lower limbs; and point of view between the eyes and the monitor. By looking at Figure 14, Ergonomic design of equipment and work stations aims to ensure that workers feel comfortable carrying out activities and ensure safety able to produce high productivity, therefore the equipment design must be appropriate with the worker's body dimensions (Purnomo, 2013)

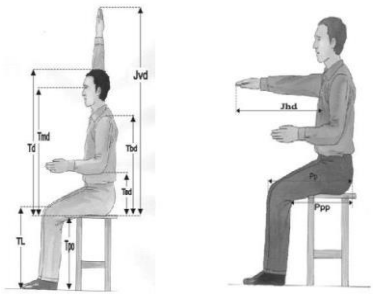

Figure 14.
Body dimensions measured for seated it position
Source: (Purnomo, 2013)

The determination of maximum and minimum table height is essential to ensure that the desk accommodates users with varying body dimensions and working postures. Appropriate height adjustment allows users to maintain an ergonomic position, reducing strain on the neck, shoulders, and back during prolonged laptop use. Table 4 presents the determination of the maximum and minimum table heights.

Table 4.
Determining maximum and minimum table height

Type of Work	Work Surface Height (cm)	
	Men	Women
Very precise work	99-105	89-95
Work requiring accuracy	89-94	82-87
Light work, writing	74-78	70-75
Heavy work	69-72	66-70

Source: (Purnomo, 2013)

Based on figure 15 and 16, for writing, reading and typing work, a table tilt is required with the angle of the table depending on work needs. The angle of inclination of the work table surface is around 5° up to 15° as needed (Purnomo, 2013)

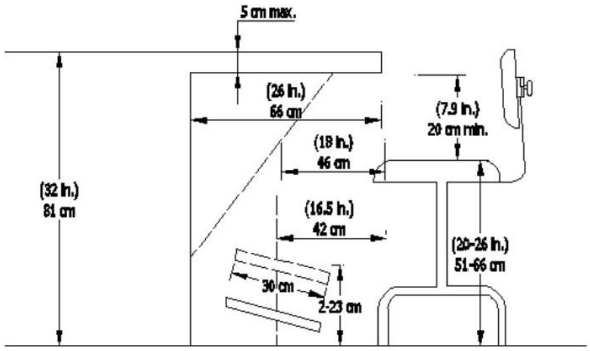

Figure 15.
Work area design dimensions for seated operators
Source: Purnomo (2013)

Research conducted by Delleman (1999) in Purnomo (2013) on workers with typing activities from various monitors. The experimental results show that the operator feels

comfortable if the monitor height is between 5 cm above sitting eye level to 40 cm below sitting eye level with a seat backrest tilt angle of 15°

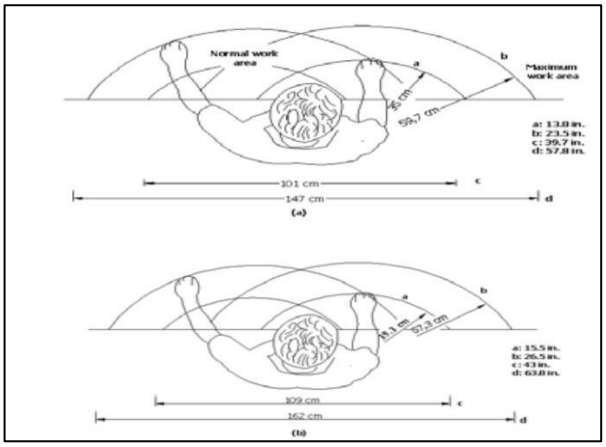

Figure16.
Normal and Maximum Working Areas for Female (a) and Male (b) Operators
Source: (Purnomo, 2013)

Base on above analysis, we propose design table with rough dimension as figure 17.

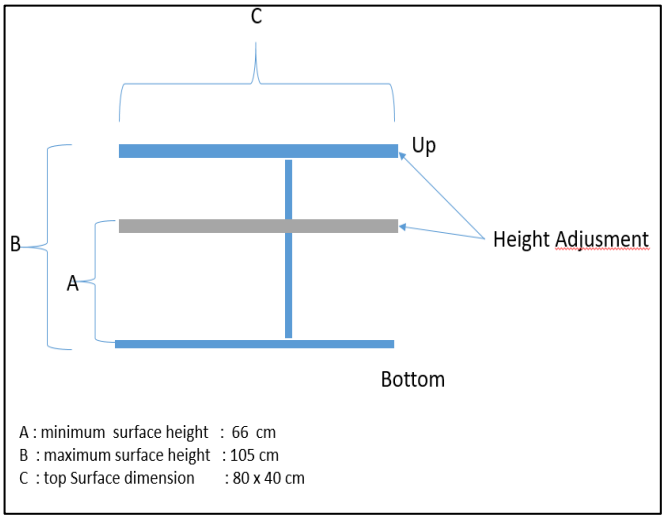

Figure17.
Ergonomic product dimension design

In addition to the adjustable height, the tilt of the table surface can also be adjusted so that the tilt can be adjusted according to the design adjustment range for the tilt as shown in the following figure18.

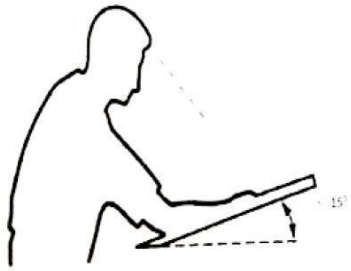

Figure18.
Table tilt adjustment for manual work
Source: (Lusiana *et al*, 2021)

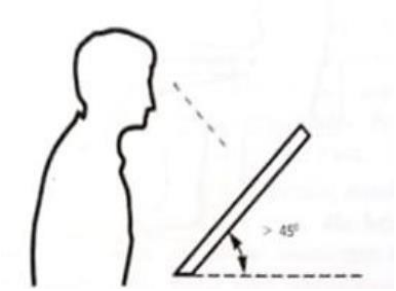

Figure 19.
Table tilt adjustment without manual work
Source: (Lusiana *et al*,2021)

In addition to adjustable height, the tilt angle of the table surface is also designed to accommodate various work activities and user preferences. The ability to modify the surface inclination enhances visual comfort and helps maintain a neutral wrist and neck posture during typing or reading tasks. According to ergonomic design standards, the optimal tilt range varies depending on the type of work performed. For manual or precision tasks, a steeper tilt angle is recommended to improve visibility and reduce forward bending, while for non-manual or general work, a smaller tilt angle is sufficient to maintain comfort and stability. The reference design range for the table tilt adjustment is illustrated in Figures 18 and 19.

4.4.2. Table Set up and prototype

Based on the ideation phase, design 2 was made into a prototype as shown in the following figure 20

(a) Design (b) Prototype

Figure 20.
Design for prototype

Below are example of prototype of table, In addition to adjustable height, the tilt angle of the table surface is also designed to be adjustable to accommodate various types of work activities and individual preferences of users. The capability to modify the inclination of the tabletop not only enhances visual comfort but also plays an important role in maintaining a neutral position of the neck, shoulders, and wrists during extended periods of laptop use. An appropriate tilt angle can reduce visual fatigue, minimize muscle tension in the upper limbs, and promote a more natural line of sight between the eyes and the screen. According to ergonomic design principles, the optimal tilt range for a work surface depends on the type

of task performed. For manual or precision work, such as writing or sketching, a steeper tilt angle of approximately 10°–20° is recommended to improve visibility and reduce forward bending of the torso. Conversely, for non-manual activities such as typing or reading, a smaller tilt angle of around 5°–10° is generally sufficient to maintain stability and comfort without causing the laptop to slide. The reference design range for these tilt adjustments is illustrated in Figures 18 and 19, serving as a guideline for achieving an ergonomic balance between usability, comfort, and safety in long-duration work settings.

Based on figure 20, the results of the design analysis and user survey, several key priorities were identified for the development of the smart ergonomic laptop table. The product must first ensure durability, as this guarantees that the table can withstand long-term use without experiencing structural damage. At the same time, it must be lightweight to allow users to easily move it from one place to another according to their working needs. The portability feature further enhances this function, making the table more flexible and convenient for use in various environments, whether at home, in offices, or in dormitories.

Based on figure 21 to improve laptop performance and user comfort, the table is also equipped with a cooling pad, which helps maintain optimal air circulation and prevents device overheating. In addition, an electric socket with multiple power outlets is integrated to provide convenient access for charging laptops and other electronic devices without the need for an external power source. The most important ergonomic features include adjustable height and surface angle, allowing users to customize the table's position for optimal posture, thereby reducing the risk of musculoskeletal disorders such as neck, shoulder, and back pain. Overall, these features were prioritized based on user expectations and ergonomic design principles to create a durable, multifunctional, and health-oriented product.

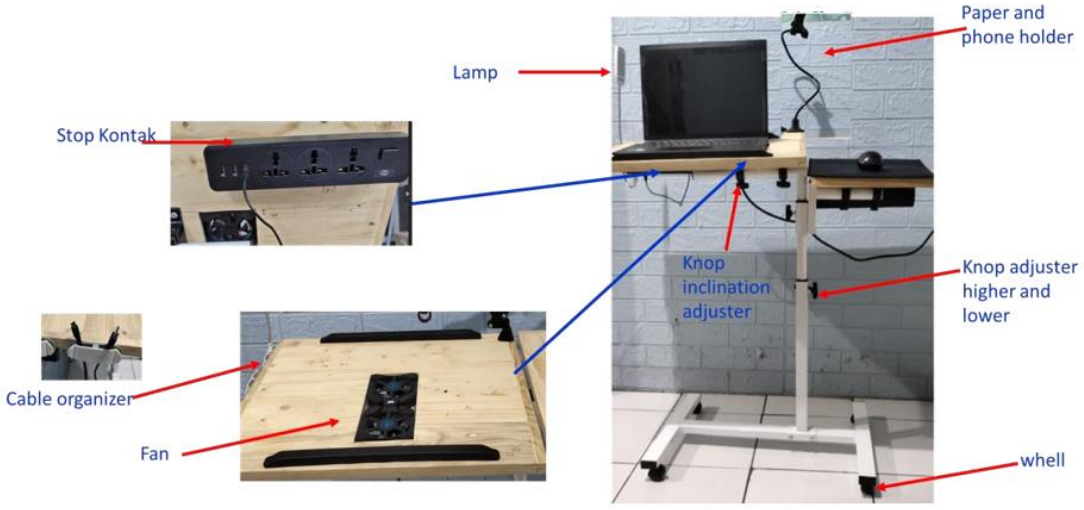

Figure 21.
Table Feature

4.5 Testing

Structure analysis is done based on the created design to see the capability of the proposed design. It was divided into stress analysis, displacement analysis, and strain analysis.

4.5.1. Stress Analysis

Based on figure 21 stress analysis is a study that is used for determining the stress and strain level subjected to force. Based on the figure, most of the stress was observed in the top beam of the table when applied with 100 newton of force. This is due to the beam is the direct support for the table and side table. Based on the figure, the design prove to be strong enough to support the force of 100 newton.

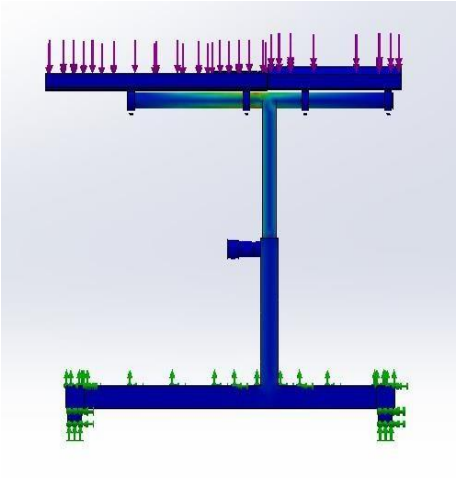

Figure 21.
Stress analysis

4.5.2. Displacement Analysis

Based on figure 22 displacement is a condition where an object change position from the original position. In this case, the observed change is the change of object position if applied with force. When applied with 100 Newton force on each of the position, most of the table surface proved to be able to hold the force. But the edge of left sided table is getting weaker. Overall, the table should be able to hold the force applied to it.

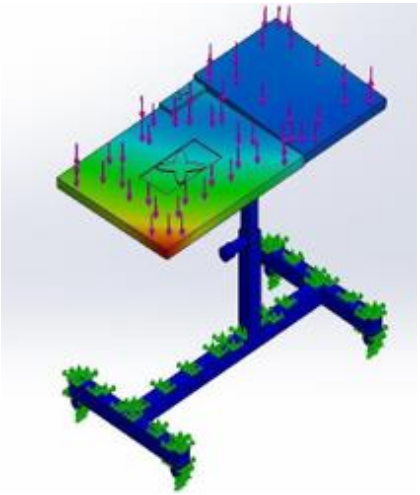

Figure 22.
Displacement analysis

4.5.3. Strain Analysis

Strain Analysis is used to see the stress and strain in the material when applied with force. During the simulation, when applied with 100 Newton. of force there is only small

amount of strain in the surface of the table. It's a prove that the design capable of holding the given force with minimal strain. A force of 100 Newtons was applied because the test load was simple and sufficiently representative to demonstrate the design's ability to withstand force, strain Analysis can be seen in the figure 23.

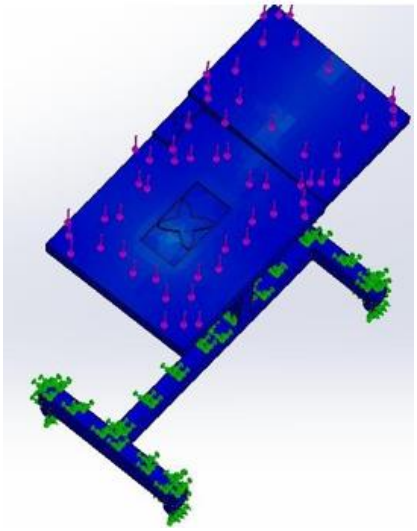

Figure 23.
Strain analysis

4.6 Assess

A modern and minimalist ergonomic desk design provides optimal comfort during prolonged laptop use. It promotes proper posture and helps prevent common injuries such as repetitive strain injury (RSI), carpal tunnel syndrome, neck pain, and back pain. In addition to improving work efficiency, its modern and minimalist form enhances spatial utilization and workplace aesthetics. During the initial design, the beam is too small and cause deformity. Based on figure 24 the deformation is worse than the improved design. This is due to the small beam could not handle the force allocated to the surface of table.

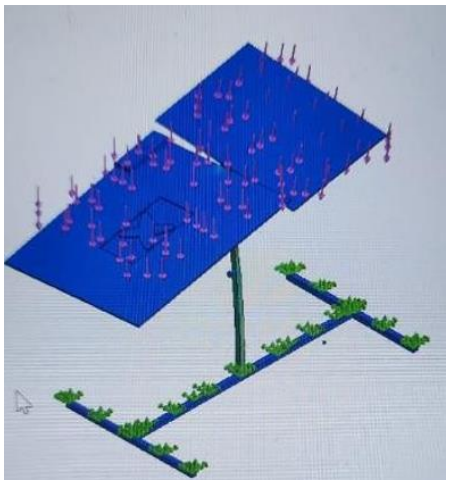

Figure 24.
Deformity

Therefore, to improve the situation, a larger beam is used. The result shown in Figure 21, 22 and 23 prove to be satisfactory in term of strain, displacement, and stress. Recommended improvements include adjusting desk height and angle for proper posture,

using lightweight and durable materials, and adding portable, flexible features. An ergonomic and space-efficient design is expected to enhance user comfort, health, and productivity.

5. CONCLUSION

The ergonomic laptop table designed in this study has successfully fulfilled its main goal of providing comfort and helping users maintain proper posture during long periods of laptop use. The design features—such as adjustable height, adjustable table angle, and suitable materials—help reduce the risk of discomfort like neck pain, back pain, elbow pain, and other strain-related issues. Its simple and modern look also makes it suitable for various work environments. However, this study has several limitations, including the small number of respondents and the lack of long-term testing, which means the results may not fully represent wider user conditions. For future research, it is recommended to involve more participants, conduct long-term use evaluations, and explore additional innovations such as smart sensors or improved ergonomic analysis to produce an even better and more user-friendly design.

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