Paper ID :520

Design of a Study Table for a Computer Undergraduates with the use of Kansei Engineering

SABN Jayasundera[1#], MPWSS Peiris[1], RGGA Rathnayake[1], ADKH Aluthge[1], WGEP Weeraratne[1] and

LP Kalansooriya[1]

Faculty of Computing, General Sir John Kotelawala Defence University, Sri Lanka
[#]<38-bcs-0003@kdu.ac.lk>

Abstract *– In the present, product designs are more complicated when compared to past designs. It is important that the design of the items be attractive and comfortable to use. The study table of computer undergraduates differs from that of other undergraduates. In general, it is used to store books, arrange study materials effectively, and it should be designed in such a manner that students are encouraged to study. However, for a computing student, not only books but also devices should be placed on the study table so they can easily handle them. After analyzing these facts, the authors decided to develop a table that would be convenient for the students. The main aim of this study is to design a study table using Kansei Engineering (KE). The result of the research is based on the questionnaire, and fifteen Kansei words have been chosen. And the final design is created by considering those words and using the statistical analysis of the questionnaire. According to the analysis, authors have designed an L- shaped, medium sized study table. And it consists of monitor boards, an adjustable laptop holder, a headphone holder, sliding shelves, etc. Engineer wood is used as the material as it is durable, eco-friendly, cost- effective, and water-resistant. Furthermore, steel is used for the legs of the table, which are adjustable. That makes it more comfortable for the users.*

Keywords **– Kansei Engineering, study table, user centered design**

I. INTRODUCTION

Computer Science and technology are essential fields in the current digital era. As a result of this students are prone to select field of computing for their higher studies. Students majoring in the field of computing spend a lot of time studying and using their computers and thereby their study space layout especially the study table, plays an important role in their productivity, efficiency, comfort and all-together their academic performance.

Kansei Engineering, a Japanese word that translates to "engineering of emotions" or "affective engineering," this design methodology mainly emphasizes on taking the user emotional reactions and preferences into account. Kansei Engineering is widely used in designing products as it aids the designers to satisfying experiences by understanding and using the emotional requirements and desires of humans. In traditional design methods emotional component of product design is often disregarded, which causes user frustration and lower productivity. Some of the identified loopholes and drawbacks of the presently available study tables are as follows: lack of ergonomics, inadequate storage, and organization space, limited technological integration, insufficient connectivity options, by incorporating Kansei Engineering concepts, authors have been able to develop a study table that not only meet the functional needs but also generate positive emotional reactions, improving the study experience of a computing undergraduate.

This research paper will explore how a study table can be constructed with the use of Kansei Engineering concepts that are especially suitable for students studying computing. The design of the study table will be based on a thorough understanding of the emotional needs, preferences, and particular needs of the target users' academic activities. The goal of the research is to identify the important emotional aspects that affect how computing undergraduates study and what they expect from a study table by examining the data that has been gathered. The research will be used as a basis for creating a prototype study table design that incorporates these emotional variables and follows to Kansei Engineering principles. Findings and the final prototype design obtained from this research will help educators, ergonomics experts, and furniture designers develop more effective and user- centered study spaces.

This research paper follows the following structure: literature review, methodology, results discussion, and conclusion. Previously designed study table will be discussed briefly in the literature review section while the methodology will provide the way in which the research was carried out. The outcomes of the survey will be presented at the results section followed by a discussion of the proposed prototype.

II. LITERATURE REVIEW

Study environments play a crucial role in increasing productivity, efficiency, performance, and the overall well-being of students at large. In tailoring a study table to specifically address the needs of a computer undergraduate Kansei Engineering can be used as a powerful and effective approach as it considers the subjective experience of individuals in designing and developing the study table while incorporating the associated emotions.

Aim of this literature review is to examine similar research that have been conducted to design study tables. By synthesizing the available studies and utilizing principles of

Kansei Engineering authors expect to create a table that ultimately enhance the academic performance of a computing undergraduate.

A. Multifunctional Computer Table

A new design in order to integrate both a computer table and an ergonomic desk into one facility has been proposed. Therefore, this product is a computer table with added reading and writing facilities. This Multifunctional Computer Table consists of a folding monitor holder, a keyboard and mouse holding tray, a sliding tray with sufficient space for writing, a cabinet to hold a projector, a moveable reflecting hole for projection, plus some extra drawer space to hold needed items. The table has wheels on the bottom for easy moving. The research was conducted using interviews in order to find the additional features. Accordingly, the authors have decided to use nonferrous metallic components, high quality polymer for strong wheels, and partex board instead of wooden board. (Habib et al., n.d.)

B. Modular Study Table Inspired by DIY Concept

The study conducted by Mohamad Ali Selimin, Siti Nurul Syazira Sapari, Juliana Abdul Halip proposes a modular study table with an implementation of a self-assembling method known as do it yourself. The initial research was conducted by the data obtained through the market survey conducted by the residents of Batu Pahat, Jahoor. The developed prototype was made by using pinewood as the main material, steel for the legs of the table and light vinyl stickers as the finishing works. The proposed study table consists of features such as a notice board, chair, foldable study tabletop and drawers. The proposed table is most suitable for study spaces in small space residentials.(Selimin et al., 2020)

C. Contemporary modular study table

This is a contemporary modular study table that has been designed for small minimalist residences in Malaysia. Mainly, this is based on the concept of contemporary and modular design. The purpose of this study is to transform the parent furniture by detaching the jointing components and building different furniture structures. Here, the table was made from a mix of plywood for the surface, and the frame was coated with black paint. The specialty of the table is its flexibility. The frame was created by incorporating toy (Lego) nature into the design so that it could form alternative furniture arrangements. For the protection of the table leg, black rubber pads are used. (Selimin et al., 2019)

D. Drafting table

This table was designed by Ryan Jeffrey Curbano of LPU-Laguna based on anthropometric measurements for engineering students. The research has used developmental and descriptive methods for the study. Developmental research was used to develop the proposed drafting table. The descriptive method has been used to analyze the anthropometric measurements, posture analysis, and physical discomfort while performing drawing activities. A total of 42 engineering students were selected for the above study. The design work considered eight anthropometric data measured from those 42 students. Most of the respondents experienced discomfort and fatigue in the lower back of their body. The researcher proposed a new design for drafting tables based on their anthropometric measurements. The proposed table has a height of 65.74 cm ± 8.88 cm, a length of 85 cm, a width of 51.82 cm, and an adjustable desktop angle of 30º - 45º.(Curbano, 2015)

Table 1. Comparison of existing systems

Name of Table	Multifunctional Computer Table	Modular Study Table	Contemporary Modular Study Table	Drafting Table
Monitor holder	x			
Projector holder	x			
Writing space	x	x	x	
Wheels	x			
Modular		x	x	
Extra storage space	x	x	x	
Notice board		x		
Adjustable Desktop				x

Source: Authors

III. METHODOLOGY

Kansei engineering methodology is one of the mainly used methods for developing the design of our product. The Japanese have permeated this Kansei engineering in most of their industries such as automotive, electrical appliances, construction, clothing, etc. They have been enabled to provide revolutionary products by understanding sophisticated consumer desires. Nagamachi saw that companies regularly wanted to quantify customers' impressions of their goods or services. He decided to research developing products by considering customers' emotions. (Mitsuo Nagamachi, 2008) Figure 1 below will show the flow of Kansei engineering.

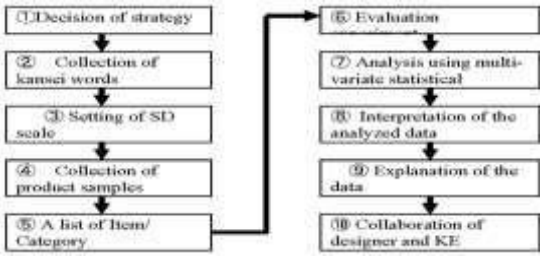

Figure 1. Flow of KE Source:(Nagamachi et al., n.d.)

Kansei engineering is an emotional design methodology that enumerates the mapping between product features and emotions. The steps of KE can be defined as collecting Kansei words, setting a 5-point SD scale for those selected Kansei words, analyzing the Kansei words, statistical analysis of the gathered data, interpreting of analyzed data and explanation and collaborating with designers to represent the results.

This research was conducted by means of questionnaires, and data gathered through observations. (Habib et al., n.d.). The targeted audience for the survey is computing undergraduates. This included feedback about existing table designs and features for the proposed table designs. Thus, collected feedback and the new features helped the authors to create a product that is multi-functional in design which will be discussed in the results section.(Nagamachi, 1995)

IV. RESULTS

Kansei engineering consists of some steps such as selecting suitable Kansei words, Kansei evaluation experiment, and statistical analysis procedure. The evaluation of Kansei consists of the evaluation given for design samples by the participants. The statistical analysis procedure analyses the relationship between Kansei words and design elements.

A. The Collection of Kansei Words

The authors have selected 15 terms that have been compiled into a new database for designing the study table for computing undergraduates are shown in Table 2.

Table 2. KE words

Comfortable	Convenient	Durable	Spacious	Unique
Size	Quality	Simple	Impressive	Flexibility
Neat	Attractive	Stylish	Strong	Functional

Source: Authors

B. Weighting

The Kansei words with the highest grades and weights were selected and those words were put into a separate table. The grades and weights of the above words are in Table 3. The team's chosen five words and their meanings are in Table 4. Table 5 consists of the positive and negative correlation to the Kansei Words.

$$The\ weight\ of = \frac{(Total\ grade\ of\ the\ word)}{(Levels\ in\ the\ chosen\ SD\ scale * No.of\ participants)}$$

Equation 1. Equation to find the weight of kansei words Source:(Tharuka et al., n.d.)

Table 3. Grading and weight of Kansei words

Kansei word	Grade	Weight
Comfortable	190	0.666667
Convenient	173	0.607018
Durable	167	0.585965
Spacious	173	0.607018
Unique	132	0.463158
Size	103	0.361404
Quality	136	0.477193
Simple	100	0.350877
Impressive	92	0.322807
Flexibility	237	0.831579
Neat	78	0.273684
Attractive	181	0.635088
Stylish	157	0.550877
Strong	144	0.505263
Functional	177	0.621053

Source: Authors

Table 4. Meanings

Kansei Word	Meaning
Convenient	Involves very less effort
Flexibility	Easy to modify
Comfortable	Physical ease and free from stress.
Spacious	Having enough room or space.
Durable	Ability to withstand wear or damage for a long time.

Source: Authors

Table 5. Positive and negative correlations

No	Kansei words	Positively correlated to KW	Negatively correlated to KW
1	Flexibility	Adaptable Transformable Accommodating	Inflexible Unadjustable Immobile
2	Comfortable	Pleasant Relaxing Comfy	Uneasy Discomforting Restless
3	Convenient	Easy-to-use Efficient Accessible	Complicated Inefficient Time consuming
4	Spacious	Wide Large Roomy	Small Narrow Crowded
5	Durable	Long-lasting Well-built Strong	Unstable Fragile Breakable

Source: Authors

C. Relating Kansei Engineering with Engineering Characteristics

The characteristics are identified using Kansei engineering words, and those words are combined in a questionnaire. Each question consists of a requirement that is related to the KE words. The questionnaire was conducted consisting of two parts which are to collect functional and non-functional requirements for the study table. The questionnaire was distributed among 57 participants.

From the questionnaire, the authors have evaluated the functional requirements for designing the study table by taking the size and the material into consideration. The size of the design was categorized into small, medium, and large. As for the material, the choices were wood, steel, glass, plastic, and engineered wood.

Table 6 shows the most preferred table size and Table 7 shows the most preferred material type for the study table design. Answers from 1 to 5 define dislike, slightly dislike, neutral, slightly like, and most like. These results are represented graphically using the figure 02 & 03, the authors then concluded that most of the users prefer a design with a medium-sized study table made with engineered wood.

Table 6. Most preferred table size

Answer	Small	Medium	Large
1	16	5	11
2	29	15	23
3	1	4	9
4	7	13	6
5	4	20	8

Source: Authors

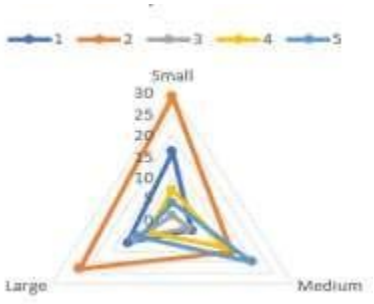

Figure 2. Spider web chart for the preferred table size Source: Authors

Table 7. Most preferred material types

Answer	Steel	Wood	Glass	Plastic	Engineered wood
1	15	14	16	16	7
2	24	20	20	21	14
3	11	12	14	13	10
4	4	7	4	4	9
5	3	4	2	2	17

Source: Authors

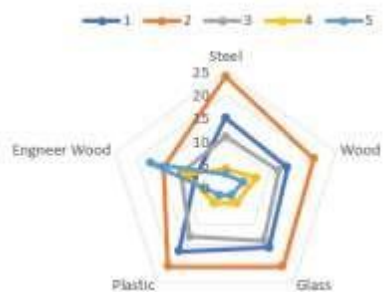

Figure 3. Spider web chart for the preferred material types Source: Authors

D. Final Design

After following the above-stated procedure, the design of the study table for computing students is as follows. Figure 4 will depict the final design of the study table.

Figure 4. Prototype design Source: Authors

E. Survey Results

The main objective of this survey was to design a study table to facilitate the needs of a computing undergraduate by using Kansei engineering. About 57 computing student responses were collected in conducting the survey.

In considering the statistics more than 50% participants prefer to purchase a study table in the price range LKR 12,800 – LKR 25,600. Going by the current trends, most of the survey respondents prefer a modern design study table. More than 40% of the respondents prefer to use a study table made out of engineered wood this might be because of durability, cost effectiveness, eco- friendliness. Over 75.4% of respondents have mentioned that they don't look for any specific color for their study table.

Overall, ten features were proposed by the authors through the questionnaire and after analyzing the responses of the participants the top five most selected features were incorporated into the proposed prototype. The selected features are adjustability, adequate legroom, storage space and convenience.

V. DISCUSSION

The authors finalized the design of the study table for the computing undergraduates, after thoroughly analyzing the collected survey results from the participants. Kansei is based on human feelings and a design that is made using Kansei will affect human emotions. The goal of this research is to come up with a design that will be engaging to the users as well as serve the functionalities optimally.

The material for the study table was chosen with careful consideration for constructing the table. As for the material for the study table authors have selected engineered wood. Engineered wood was selected because it has many benefits such as being eco-friendly, cost-effective, minimal wastage, water and moisture-resistant, durable, and sturdy, etc.

As for the shape of the study table, an L-shape was selected since most of the participants wanted a medium-sized study table. So, it was easy to design the manage the space of the table to satisfy the customer's needs.

The table consists of monitor boards, wire sockets, an adjustable laptop holder, sliding shelves, a headphone holder, a mounted tabletop, a keyboard, and a mouse placing area. This table consists of three adjustable table legs made of steel. It enables the user to adjust the height of the table.

The dimensions of the study table were decided according to the requirements of the computing undergraduates. The selected dimensions are shown below in Figure 5.

Figure 5. Dimensions Source: Authors

VI. CONCLUSION

The purpose of this study was to design a study table for computing students integrating Kansei Engineering. The study was conducted by specifically targeting computing undergraduates by considering the preferences for a study table. Emotional responses of the participants were collected through a set of Kansei words that are related study table.

After analyzing the issues faced by computing students with their current study desks, the authors have proposed a design

that caters to the needs of a computing student. Traditional computer tables and study desks have evolved to include features like height adjustment, ability to fold and unfold components and abstract shapes in addition to the conventional storage/writing spaces and cable holes.

The demonstrated study table is of an L shape with the ability to utilize the entire length of the bottom shelf for writing, keyboard, and mouse placements. The top shelf was designed in such a way that the student's things stored along it is easily accessible by the student even while sitting. The table can support the weight of multiple monitors. There is also a laptop holder which can be adjusted to a desired angle. There are two drawers with sliding doors for extra storage space and the desk height is adjustable. This is helpful for computer students in their daily use of the computer and studying for prolonged periods of time.

By incorporating Kansei engineering principles to design the study table, the user experience and the emotional involvement was enhanced.

REFERENCES

Curbano, R.J., 2015. DEVELOPMENT OF AN ERGONOMICALLY DESIGNED DRAFTING TABLE AND CHAIR FOR ENGINEERING STUDENTS OF LPU-LAGUNA BASED ON ANTHROPOMETRIC MEASUREMENT 4.

Das, R., Uddin, M.R., Islam, M., Rashid, H., Robin, M.S.R., 2017. A New Approach of Portable Smart Table for Interactive Class Room.

Du, T., Iwakiri, K., Sotoyama, M., Tokizawa, K., 2022a. Computer and Furniture Affecting Musculoskeletal Problems and Work Performance in Work From Home During COVID-19 Pandemic. J. Occup. Environ. Med. 64, 964–969. https://doi.org/10.1097/JOM.0000000000002622 Du, T., Iwakiri, K., Sotoyama, M., Tokizawa, K., Oyama, F., 2022b. Relationship between using tables, chairs, and computers and improper postures when doing VDT work in work from home. Ind. Health 60, 307–318. https://doi.org/10.2486/indhealth.2021-0222

Habib, A., Taher, G.A., Saha, M., 2013. MULTIFUNCTIONAL COMPUTER TABLE.

Kalhari, A., Wickramarathna, N., Yapa, L., Nandasena, D.,

VII. Kalansooriya, L., 2020. Development of Automated Aquatic Taxi for Sri Lanka using Kansei Engineering Concept.

Lei, Q., Zhao, Q., Zhang, Z., 2015. Study on the Materials Design of Furniture Based on Kansei Engineering 4.

Nagamachi, M., 1995. Kansei Engineering: A new ergonomic consumer-oriented technology for product development. Int. J. Ind. Ergon. 15, 3–11. https://doi.org/10.1016/0169-8141(94)00052-5

Nagamachi, M., Tachikawa, M., Imanishi, N., Ishizawa, T., Yano, S., 2008. A successful statistical procedure on kansei engineering products.

Nanayakkara, N., Abeyasinghe, U., Pabasara, B., Karunaratne, M., Wisidagama, N., Dharmasiri, N., Dissanayake, S., Kalansooriya, P., 2022. Development of A Smart Ring Series using Kansei Engineering.

Purnomo, H., Kurnia, F., 2018. Ergonomic Student Laptop Desk Design Using the TRIZ Method, in: 2018 4th International Conference on Science and Technology (ICST). Presented at the 2018 4th International

Conference on Science and Technology (ICST), IEEE, Yogyakarta, pp. 1–4. https://doi.org/10.1109/ICSTC.2018.8528575

Selimin, M.A., Hasanuddin, S., Halip, J.A., Bon, A.T., 2019. Contemporary Modular Study Table for Small Minimalist Residence in Malaysia.

Selimin, M.A., Sapari, S.N.S., Halip, J.A., 2020. Modular Study Table Inspired By DIY Concept. Solid State Technol. 63.

Tharuka, L., Amarasinghe, G., Perera, T., Nishadi, R., Waidyaratne, P., Gayanika, S., Kalansooriya, P., 2022. Designing a Bag for Computing Students of General Sir John Kotelawala Defence University by Using a Kansei Engineering Methodology.

AUTHORS

MPWSS Peiris is currently a 3rd year B.Sc. Computer Science undergraduate at the Department of Computer Science, Faculty of Computing of General Sir John Kotelawala Defence University.

SABN Jayasundera is currently a 3rd year B.Sc. Computer Science undergraduate at the Department of Computer Science, Faculty of Computing of General Sir John Kotelawala Defence University.

RGGA Rathnayake is currently a 3rd year B.Sc. Computer Science undergraduate at the Department of Computer Science, Faculty of Computing of General Sir John Kotelawala Defence University.

ADKH Aluthge is currently a 3rd year B.Sc. Computer Science undergraduate at the Department of Computer Science, Faculty of Computing of General Sir John Kotelawala Defence University.

WGEP Weeraratne is currently a 3rd year B.Sc. Computer Engineering undergraduate at the Department of Computer Engineering, Faculty of Computing of General Sir John Kotelawala Defence University

Dr. Pradeep Kalansooriya is currently the Head of the department of Computer Science. And he is also a senior lecturer in the department of Computer Science in the Faculty of Computing at General Sir John Kotelawala Defence University.