A KANSEI-ENGINEERING-BASED ACTIVE LEARNING MODULE FOR FAMILIARIZING MIDDLE-SCHOOL STUDENTS WITH BASICS OF PRODUCT DESIGN

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ABSTRACT

The paper proposes a methodology for developing an active learning module adapted from the Kansei Engineering methodology that intends to engage and familiarize middle school students with basics of product design and the Kansei product design and culture, and develop design skills. The module includes an identification of the design elements of a selected product, the creation of an items/categories matrix, product clustering according to different criteria (shape, material, principle of operation), an analysis of product functions and main product characteristics, and an evaluation of products with a Kansei scale created by the students. This series of activities lead to a design-thinking-based product-design project culminating in the construction and evaluation of prototypes. It carefully considers how students can gradually learn by going from activity to activity leading to a design project. In doing so, important skills such as, among others, analytical thinking, divergent thinking, and critical thinking are intended to be practiced.

Keywords: Education, Design education, Design process

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Cite this article: Papantonopoulos, S. (2023) 'A Kansei-Engineering-Based Active Learning Module for Familiarizing Middle-School Students with Basics of Product Design', in *Proceedings of the International Conference on Engineering Design (ICED23),* Bordeaux, France, 24-28 July 2023. DOI:10.1017/pds.2023.22

https://doi.org/10.1017/pds.2023.22 Published online by Cambridge University Press

1 INTRODUCTION

Research and practice have recognized that incorporating active learning into teaching curricula is more effective for achieving a positive learning outcome compared to more passive approaches. The objective is to endow young people with developed soft social skills, allowing them to decide, defend, debate, and describe complex problems (Kolodner et al., 2003), and the engineering skills required in the workplace, such as teamwork, problem-solving, and analysis (Ito and Kawazoe, 2015) to respond to challenges in the future. Several challenges arise from the integration of the active learning concept. One of them is that "active learning is potentially problematic for teachers since it appears to place them in a more side-lined teaching role than they are accustomed to" (Drew and Mackie, 2011). Teachers may also have to spend more energy and time on assessment, preparation, and grading outside of the classroom; very importantly, they need suitable teaching materials. Teachers encounter obstacles in selecting appropriate problems and topics within thematic, scientific, and problem-based learning and in managing time in project-based learning due to difficulties in selecting suitable techniques, developing good instruments, and formulating clear evaluation criteria (Retnawati et al., 2017). The availability of well-designed materials to support teachers in applying the active learning approach is still limited. According to Herro and Quigley (2016), when implementing, for example, STEAM, each teacher modifies existing practices rather than providing entirely new instructions. The objective of this paper is to adapt the Kansei Engineering (KE) methodology to the development of product-centered active learning activities with the intent to engage and familiarize middle-school students with product design and the Kansei design and culture itself.

2 THE KANSEI ENGINEERING METHODOLOGY AND ITS SUITABILITY FOR THE DEVELOPMENT OF ACTIVE LEARNING ACTIVITIES

Kansei Engineering is a product design method that aims at the development or improvement of products and services by translating customer feelings and needs into design parameters (Nagamachi, 2016). The name of the method comes from the Japanese word for sensitivity (感性, kansei) and "implies psychological feeling and needs in mind" (Nagamachi, 2016). The term "Kansei" is associated with engineering, science, design, philosophy, sociology, marketing, and information. Despite being a statistically and mathematically advanced methodology, KE has the following qualities that make it adaptable and effective for the scope of active learning: (a) has well-defined stages from which a selection can be made; (b) applies multiple methods for the analysis and assessment of product design, including morphological analysis, cluster analysis, the Taguchi method, the Affinity Diagram Method, or the KJ Method (Kawakita, 1991); (c) allows for flexibility in the level of difficulty as different statistical methods can be adapted or substituted by manual calculations; (d) has continuity, meaning that each stage can be used as a stepping stone to the next stage leading to the final project; (e) employs Kansei words (KWs) reflecting customer needs for performing an assessment of a product, a process which allows playing with adjective words expressing different qualities of the product; and (f) addresses the emotional and the cultural aspects of product design.

The KE methodology can be properly adapted to the development of product-centered active learning activities by manipulating the level of difficulty of the exercises and the sophistication of statistical analyses. This can be done by the following ways. First, simplification can be achieved, e.g., by selecting simple products consisting of a small number of parts or by reducing the number of KWs, items, and categories. Then, the selection of the stages to be performed by the students can be confined to those that can be performed manually along with a certain reduction in complexity, e.g., by reducing the number of representative samples. Third, the replacement of statistical computer programs with simple mathematical calculations, e.g., by performing the assessments of a small number of samples with a short Kansei scale by simple mathematical calculations (e.g., additions, calculation of average values, etc.). Stages that can not be performed without statistical computerized programs, e.g., the validation of the questionnaire, the determination of significant statistical differences between KWs, or connecting the design elements (Des) with the customer feelings, can be avoided.

The proposed product-centered active learning activities employ a number of helpful educational practices that aim at supporting active learning and multiple perspectives.

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(1) Short exercises are used to explain principles and techniques and engage students in actual engineering practices; (2) Images and schemes –instead of words– are highly utilized for the visualization of information so that the students can acquire an understanding of design principles and the product structures at a glance; (3) Each product is viewed within a "family" of similar products affecting student perception and understanding of why some products stand out; (4) Examples of products show how different designs respond to different customer needs; (5) Examples from everyday-life products are used to provide an introductory understanding of statistical phenomena by carrying out simple mathematical calculations; (6) Teachers act more as facilitators and supporters.
In previous research, the KE methodology was used in an educational context to design courses for online interactive learning (Ismail and Lokman, 2020), virtual learning (Ramachandiran and Jomhari, 2018; Khairuddin et al., 2018), and video-based learning (Adnan and Redzuan, 2016; Hj Mohd. Naim, 2022), and architectural education (Plazaola at al., 2016). It was also applied for the assessment of student satisfaction with lectures and teaching materials with the aim of adjusting them to student preferences (Chuah et al., 2008; Sugimoto and da Silva, 2014), as well as teach programming (Razumowsky, 2021). Here the concept of the proposed module does not use the KE methodology to create a new educational system or to teach product design through KE, but adapts stages of the methodology itself as hands-on activities to familiarize the students with basic elements of product design. The study responds to the need for instructional materials for middle school students that introduce them to fundamental elements of product design, ending in a product design project.

3 DEVELOPMENT OF THE LEARNING MODULE

The development of the active learning module necessitated the development of a methodology of its own outlined as follows:

- Set clear outcome objectives
- Formulate the main criteria underlying the selection of an appropriate product
- Conduct a comparative Internet search on various appropriate products (everyday products that students are likely to have been using)
- Select a product according to the formulated criteria
- Conduct a Google search on the selected product
- Organize the collected information: group all collected topics by the Affinity Diagram Method into more agglomerated themes related to the selected product. Eliminate unrelated topics.
- Develop an introductory section to evoke interest
- Adapt suitable stages from the KE methodology into simplified activities related to the selected product
- Create the needed templates for the activities
- Get feedback questions after each activity
- Test the activities to determine the timeline and identify possible issues
- Prepare the materials for the design project
- Prepare a folder with the needed materials for each student

3.1 Selection of the product

An appropriate product was selected based on the following criteria: simple (of 2 main parts); allows manual assembly of its parts; is available in a big variety of shapes, materials, and colors; is available in technical and non-technical types and eco-friendly variations; can be linked to interesting and useful sub-topics; and is funny. Several products were considered among everyday products that students are likely to have been using, e.g., a hand juice-maker, hand scissors, a nutcracker, clothespins, a hanger, a flyswatter, a pizza cutter, a kids' toothbrush, etc. These products were researched on the Internet by the use of three types of search queries: a Google search, a Google Image search by the use of keywords, and a search with the web-based open-source tool InfraNodus for generating insights from any text or discourse.
Based on the above criteria, the flyswatter was selected as the product for a case study. Next, the themes were classified by the Affinity Diagram Method and the most relevant themes were selected so that, on one side, the selection of themes is broad enough to cover multiple areas, but, at the same time, narrow enough to keep the students' interest on the main topic.

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3.2 Structure of the active learning module

The active learning module has 4 parts (Figure 2). (1) An introductory part including a presentation of the selected product linked to other relevant topics. This follows a thematic approach to learning in which understanding of the main subject can be deepened by presenting important related sub-topics; (2) A series of activities adapted from the KE methodology. (3) A product design project. And, (4) An assessment of the learning module.

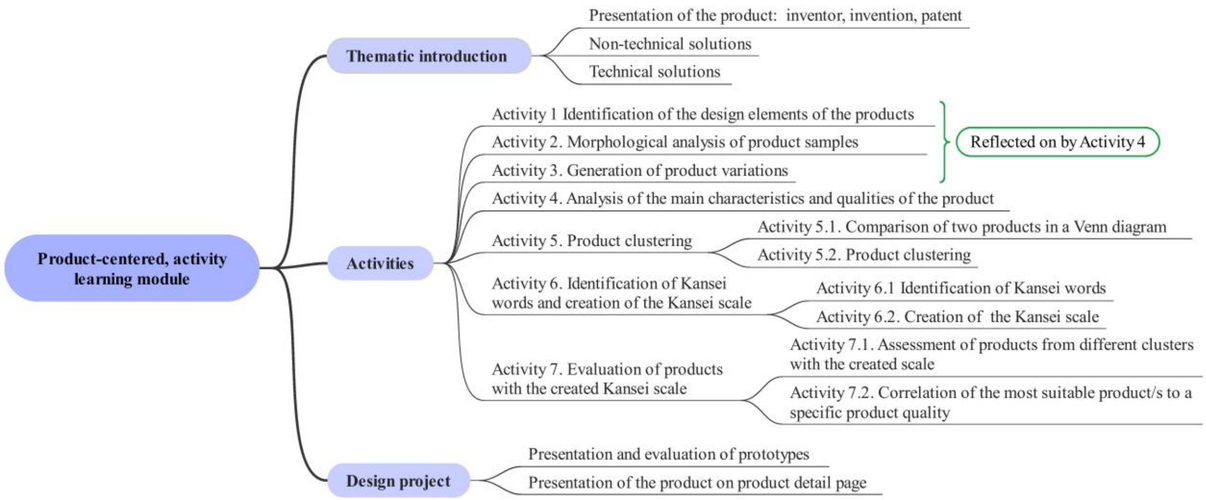

Figure 1. Structure of the active learning module

Whom is it designed for: According to the level of understanding of mathematics required, the module is deemed more appropriate for middle-school students. However, the degree of difficulty can be adjusted by increasing or decreasing the complexity of the product and/or the statistical analysis. **Main goal:** Familiarization with introductory concepts of product elements and product functions. Level of difficulty: Flexible. The module is presented as a sequence of activities using one product in order to maintain continuity and to increase its effectiveness by building understanding in each activity; however, every exercise can be performed separately or with different products. **Applicability:** High. No special equipment and supporting materials are required. **Diversity:** High. Allows the selection of different products, from everyday products to more complex technological products. Low complexity products are preferable for better understanding of the basic principles.

4 CASE STUDY

4.1 Introduction. Presentation of the flyswatter

The presentation of the flyswatter includes the history of the product and its inventor, as well as a collection of product images carefully chosen to highlight various aspects of the product. This introduction to different designs of the product is achieved in an interactive way, first asking a question related to user needs and then showing how the designer responded with his/her design. The analysis of the product group shows that, while most product designs are the result of improving the product's usability, some of them have secondary, decorative or advertising functions, while others are created as art objects. In this regard, detailed information is given about several concepts of the product: the "speaking" flyswatter (with a built-in speaker playing fun phrases like "We got it!", "Touchdown!", and others), the "first invention in 1900", the "Give-the-Fly-a-Chance", the one "with attached tweezers", the "extendable handle", the "standing with a spider in a net", the "advertiser" with a head for advertising text, the "fly gun", a high-design flyswatter by Alessi, and others. Non-technical, less technical, and technical solutions can be also presented linking the flyswatter to other relevant topics. The introduction follows a thematic approach to learning in which understanding of the main subject may be deepened by presenting important related sub-subjects. The information available on the Internet may be used to this end (Shoemaker, 1991). Evidence suggests that learning becomes more meaningful and understanding is deeper when the themes are integrated and the material is personally relevant (Varun, 2014). In this way, subject materials are not taught in isolation. Instead, learning is connected to larger themes and concepts across multiple subjects and applied to real-world issues and problems (Martinez and McGrath, 2014). In

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this vein, the presentation of the flyswatter may be linked to the topics of invention, inventor, and patent or connected with botany and biomimicry, offering non-technical and eco-friendly solutions. For example, Carnivorous plants have developed a very impressive diversity of leaf shapes and trapping mechanisms to capture flies. The Nepenthaceae family uses pitfalls (hollow structures for the fly to fall into), the Drosera use leaves covered with a sticky substance, whereas the Utricularia plants, because of poor nutrients in the water, have developed their leaves in the shape of bags that suck the prey in a few milliseconds. Extensions of the content in the direction of trapping mechanisms transform product-centered learning to process-centered learning. The main subject may also be linked to biomimicry or bio-inspired design with examples of products created by imitating nature, e.g., flypaper with thick non-chemical glue and waterproof paper and fly bottles lined up with a fly-attracting liquid substance.

4.2 Activities based on the Kansei Engineering methodology

Table 1. Structure and content of the active learning module

Activity 1. Identification of the design elements of the product Students are asked to mentally decompose the product into its parts and identify its key features. The activity is performed individually and the result is presented as a list of design elements: One piece or two pieces; color, shapes, materials of the handle and the head, hanging type; and so on. Objective: Practicing mental product decomposition Identify the design elements of the products and discuss their properties. Skills practiced: visual thinking, divergent thinking.
Activity 2. Analysis of product samples Students are presented with a template in the form of a matrix with 10 product images and specific product DE and are asked to analyze each product to determine whether or not a specific design element is present by ticking the appropriate box. The first product is analyzed by all students as an example, then the activity is completed individually. Objective: Summarizing data about a group of products Understanding simple statistical phenomena. Draw conclusions based on the data. Types of questions: Which is the most popular color for the head and the handle? Which material is the most commonly used for the head and the handle? How many products have accessories? More products are available in one or two pieces? Other questions: Which features you might consider to differentiate it from those currently available? Skills practiced: visual thinking, analytical thinking.
Activity 3. Generation of product variations Three distinct flyswatters in 3 copies each are decomposed to give 3x3 different heads, and 3x3 different handles, a total of 18 pieces. Their manual recombination can generate 9 products. Students are given 18 cards and are asked to combine heads and handles as quickly as possible, their time measured by a timer. Then they assess how many meaningful combinations are created. The activity can be continued by a new trial with double the number of products and combining elements. Objective: Generating of product variations and assessing the created products The activity applies the Taguchi method and introduces an element of competition. Type of questions: Reflect on the learning-by-doing processes. Skills practiced: observation, attention, time management, working memory, data organization before the initiation of a task.
Activity 4. Analysis of the main characteristics and qualities of the product Students are provided with a real product and a template in the form of a circle diverging diagram showing links between the product in the center circle and the surrounding circles that feature product characteristics. They are asked to fill in the most important characteristics of the product that they have discovered up to that point, such as shape, color, material, size, and storage, or other qualities that are more difficult for students to identify themselves, such as usability, durability, flexibility, eco-friendliness, sustainability, emotional values, and aesthetic appeal. The concept of Kansei will be briefly explained at this point. Objective: Reflecting on product characteristics Types of questions: (a) Funnel: a series of questions that begin broadly about the needs of customers and gradually lead to a more specific question. (b) Focal: questions that ask students to select or justify a position. Do you agree that this is…? If so, please explain why. Why not, if not? Skills practiced: Contextualizing, taking a broad view of the environment in which, the product exists and what is required as a result. Analysis, critical thinking, communication, vision, and decisiveness.

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Activity 5. Product clustering **Activity 5.1. Comparison of two product in Venn diagram.** The activity requires identification of all possible elements that two specific products have in common in the space where the two circles overlap and all distinctive in the appropriate circle for each product. Objective: Introduction to product clustering with two products. Explaining the relationships and distinctions between objects. Skills practiced: Observation, abstract thinking **Activity 5.2. Product clustering.** Students are asked to group 20 products (flyswatters) according to their similarities and give each group an appropriate name, e.g., "standing" flyswatters. This is followed by a second level of arrangement of the groups into families and naming each family. Post-it notes can be used to write the name of the families. The process can continue by re-arranging groups by color, material, theme, originality, and so forth. After an arrangement is completed, a conclusion about the number and names of the created product groups is recorded. The activity is performed by teams of 2. Objective: Clustering of products by comparing, contrasting, and dividing products into groups that are useful, meaningful, or both. This activity reflects the students' depth of understanding and drawing conclusions about product groups. Creating a group of products with very different qualities by taking a representative sample from each cluster
Activity 6. Identification of Kansei words and creation of the Kansei scale **Activity 6.1. Identification of Kansei words.** Students are asked to get into the role of a customer and write on post-it notes adjectives or short phrases that express qualities they would like the product to have, e.g., durable, flexible, original, easy to use, funny, attractive, eco-friendly, and so on. The notes are then posted on the board, grouped by the Affinity Diagram Method, and each group is given a name (similar to Activity 3). If possible, some groups are further organized into families. In this way, the large number of words is reduced to a small number. These words are called Kansei words and express different qualities of the product. In the module they are named simply as "qualities". Objective: Identifying the desired qualities of the product. Emphasizing that the design of a product has to respond to multiple qualities Skills practiced: project management, analytical thinking **Activity 6.2. Creation of the Kansei scale.** KWs are rated by their importance on a 5 point-unipolar Liker scale from 5 (very important) to 1 (not important at all) and the most important are selected. A scale is created by the use of the most important KWs and a 5-point emoji (Google type) scale ranging from very happy (5 points) to not happy at all (1 point) with a positive adjective on one side and its antonym on the other side. Objective: Identifying the most important desired qualities of the product and creating a scale for its assessment
Activity 7. Evaluation of products with the created Kansei scale **Activity 7.1. Assessment of products from different clusters with the created scale.** Students are asked to evaluate 4-6 products from each cluster created in Activity 5.2 (Product clustering) in terms of the Kansei scale created in Activity 6.2 (Creation of the Kansei scale). The assessment is performed individually by the use of ready templates. Alternatively, it can be performed by the whole group on a scale on the board where, one by one, the students can express their feelings about the product by making a facial expression themselves and then ticking the right emoji that matches their perception of the product. Objective: Rating the products by the created Kansei scale. Rating selected products in terms of different qualities. Learning how the most preferable and the least preferable products can be identified based on the peoples' (consumers') ratings. Understanding which design element(s) contribute to making us see one product as "original" and the other as "boring" or, in general, like one and dislike the other **Activity 7.2. Correlation of the most suitable product/s to a specific product quality.** On a ready template (Figure 2) the students write on the left column the 6 positive KWs found to be the most important in Activity 6.2 and, on the right side, they must write the numbers of up to 5 products from those appearing in the template with 39 products whose designs best correspond to the specific KW/quality according to their impressions. Objective: Practicing manual correlation of the specific products with specific customer needs. Identification of a product whose design has met more than one customer requirements

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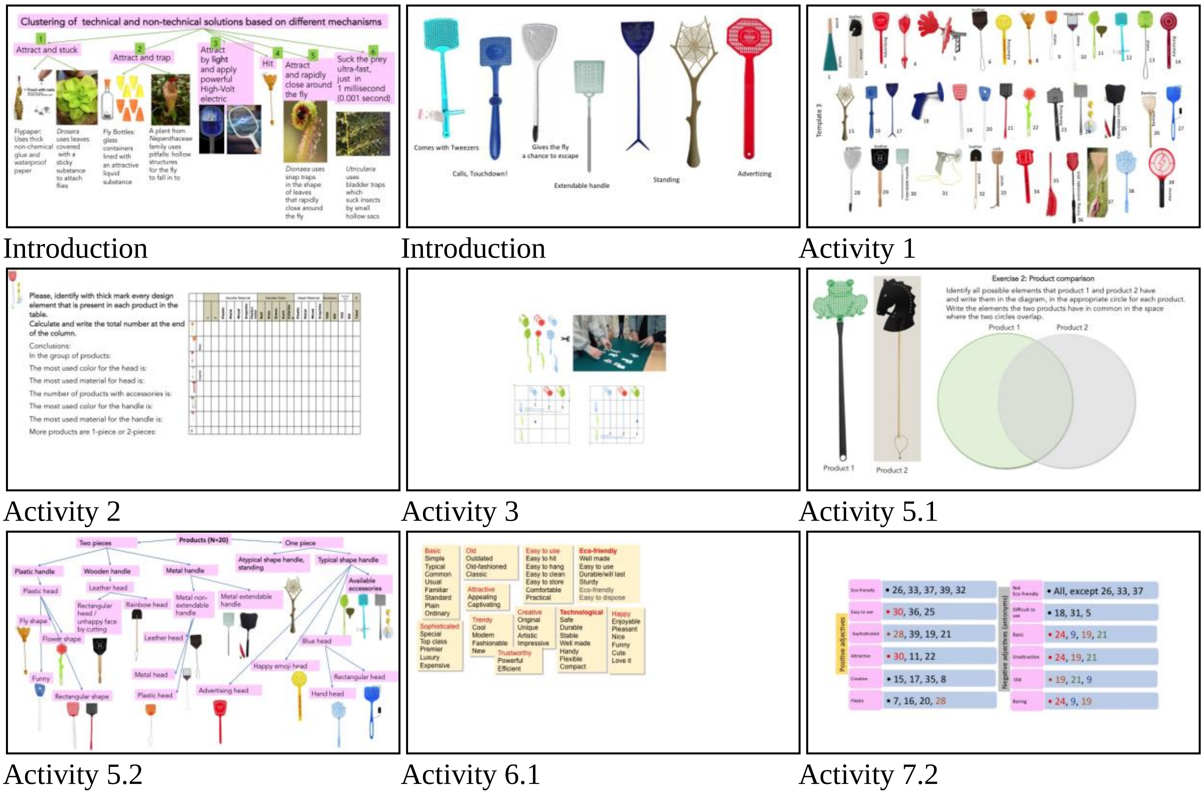

Figure 2. Examples of ready templates and other materials of the module

4.3 Design project

After completing the activities, a design project on the redesign of the flyswatter is assigned. The design project follows the basic design-thinking-based approach. Students are asked to present their product in (a) the traditional way or (b) in the form of product detail page for online sale on an e-commerce platform (e.g., an Amazon-type including a main image, a product description, an image gallery, specifications, etc.) This includes the following: Design thinking (empathizing-ideating-evaluating-prototyping-iterating). Practicing fast prototyping emphasizing the process rather the result. Testing and evaluation of the prototypes. Exploring how products can be visually and textually presented on an online platform for sale, writing a product description, creating images for visual presentation, explaining the specifications, and highlighting the product beneficial values. Skills practiced: Textual/visual/verbal expression of the idea and the product presentation. Critical thinking.

5 MODULE PILOT TESTING AND EVALUATION

The module was presented in a classroom event (2hrs with a break) where 8 students (15 years of age) were sitting on a deck on their own and re-grouped when needed. They evaluated each activity after it was completed by the use of questionnaire including a 5-point unipolar SD scale (1=totally disagree to 5=totally agree) assessing each activity on 8 indicators: "challenging", "meaningful", "easy to understand", "enjoyable" "motivating", "engaging", indicators selected from Academic Practice Department (2019), to which 2 more, "learnable", and "discovering", were added. A single-item question defined as "good for individual work" was used to assess the activities' suitability for individual or otherwise team work according to the student experience and the ratings were analyzed with Simple Correspondence Analysis (SCA). Free-text comments were requested at the end of the module as feedback of their overall impressions. ANOVA with Tukey post-hoc was used to assess the significance of differences between the ratings of the students for each activity and for their classification. Partial Least Square (PLS) analysis was performed to correlate the elements of activities (Table 2) used as dependent variables to the students' ratings for each of the 8 indicators as independent variables. For PLS-analysis purposes, all categorical variations were converted into dummy variables. Minitab®20 Statistical Software (Minitab, LLC, USA) was used for all statistical analyses.

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Table 2. Design matrix for differentiating the created activities

Category	Sub-category	Category	Sub-category
Number of products used in the activity	Very small, 2 (x11) Small, 3 (x12) Medium, 20 (x13) Large, 39 (x14)	Time to complete	Short, < 5 min (x41) Medium, 5-10 min (x42) Long, > 10 min (x43)
Competition element	Yes (x21) No (x23)	Visual examples of real applications	Yes (x51) No (x52)
Ready template used as predefined guide	Yes (x31) No (x32)	An indirect hint	Yes (x61) No (x62)

The preliminary testing of the learning module resulted in the following 3 types of results: (1) student results, (2) student evaluations of individual activities, and (2) additional observations of student performance by the author.

(1) Student results. Students performed all activities adequately. In Activity 1, given a template with 39 flyswatters and asked to list whatever they could name as a product element (what the product was made out of), students generally listed 8-15 characteristics, tough mainly visual, form-related characteristics. Only 1 out of 8 decomposed the product mentally and mentioned product components. Furthermore, only 2 out of 8 grouped the provided visual characteristics by categories. In Activity 2, given two flyswatters and asked to list their elements and form a Venn diagram with their common elements, students listed both visual characteristics and product elements. Half of them listed common product functions. These observations lead to the conclusion that students are not ordinarily accustomed to think abstractly about products but they can do so by becoming more acquainted or asked to analyze them more.

(2) Student evaluations of individual Activities. The results from the SCA showed (Figure 3, Left) that the Activities with the highest number of agreements of the students as "good for individual work" were Activities 3, 5.1, 6.1, and 7.2 whereas Activities 4 and 5.2 were not, but "good for teamwork". There was no prevalent consensus on Activities 1 and 2.

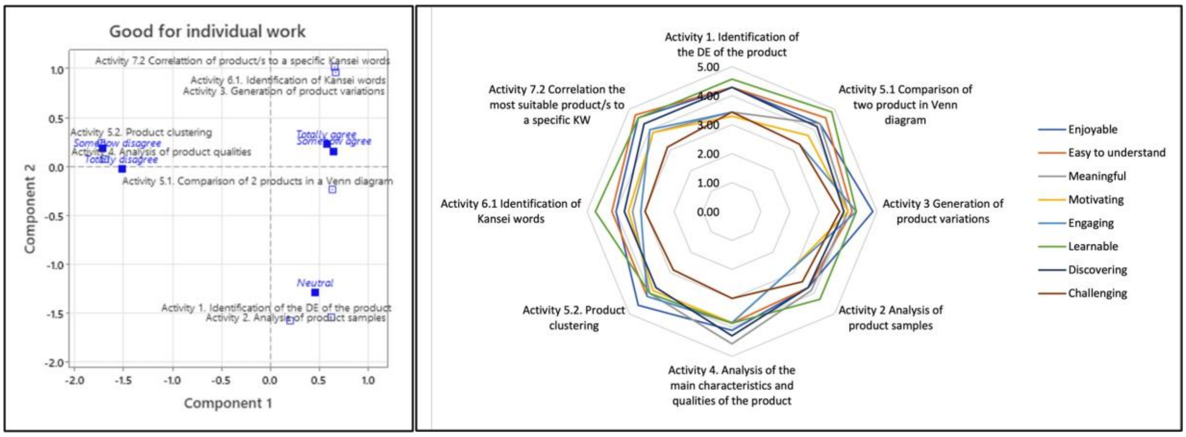

Figure 3. Left: Correspondence analysis asymmetric plot generated from students' ratings Right: Radar plot of the activities evaluation from the students' perspective in terms of different qualities.

One-way ANOVA with Tukey post-hoc was performed with the activities as dependent variables and the employed indicators as independent variables. The results revealed a significant statistical difference in the ratings of the different indicators: $F(7, 63) = 9.36$; $p < 0.001$, ($p < 0.5$). The mean values (M) of the ratings for the different indicators were in the following order: "learnable" (M=4.39±0.30) > "enjoyable" (M=4.27±0.40) > "easy to understand" (M=4.20± 0.33) > discovering (M=3.95±0.25) > "meaningful (M=3.88±0.31) > motivating (M=3.62±0.38) = engaging (M= 3.62±0.52) > challenging (M=3.23±0.29). The highest variation was found in the student ratings for the "engaging" indicator. Radar plots of the evaluations of the eight Activities show (Figure 3, Right) an overall comparison of the different indicators and indicate that, e.g., Activity 3 was found to be the most "challenging", "enjoyable", and "engaging", while Activity 4 was found to be the most "meaningful". Student ratings of Activities 5.1 and 6.1 had the highest deviation among indicators (Figure 3, Right).

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PLS analysis was used to determine the relationship between the elements of the Activities (Table 2) and the students' perceived qualities of the Activities in order to identify those that are positively influencing their impressions and that can be taken into consideration for the improvement of the module. The elements of the Activities contributing to the overall positive student impressions in the order of importance were: examples with real applications, a short (less than 5 min) duration for completing an Activity, the element of competition, the use of a small (2-3) number of product samples, offering the participants hints on how to start, a readily available template, and performing of the Activities individually (Figure 4 Left). Similar analysis was performed for each of the indicators. For example, the data showed that how the work is performed (e.g., by teamwork or individually) and whether the Activity provides a ready template are the two indicators that affected the least the "enjoyable" learning experience of the students (Figure 4 Right).

(3) Additional observations of student performance by the experimenter. Trouble Spots: a) Often students experienced difficulties to generalize/summarize in terms of giving a name of group of product qualities as, for example, "easy to hit", "easy to hang", "easy to clean", "easy to store", "comfortable", "practical" are all "easy to use"; b) When working as a team, students did not immediately assign "who is doing what," so that they could be effective in completing the task fast; and c) In some cases, they concentrated not on the goal, but on some irrelevant precisions such as cutting with scissors to make the cutting nice. Such types of Activities directly uncover how students think only by the way they initiate the task. Author observations: a) Shapes were difficult to be given names, particularly irregular ones, but, with proper encouragement for an association with objects, they could reach a suitable name, b) Students love competition, and c) Some Activities will be better to be instructed in the form of a scenario.

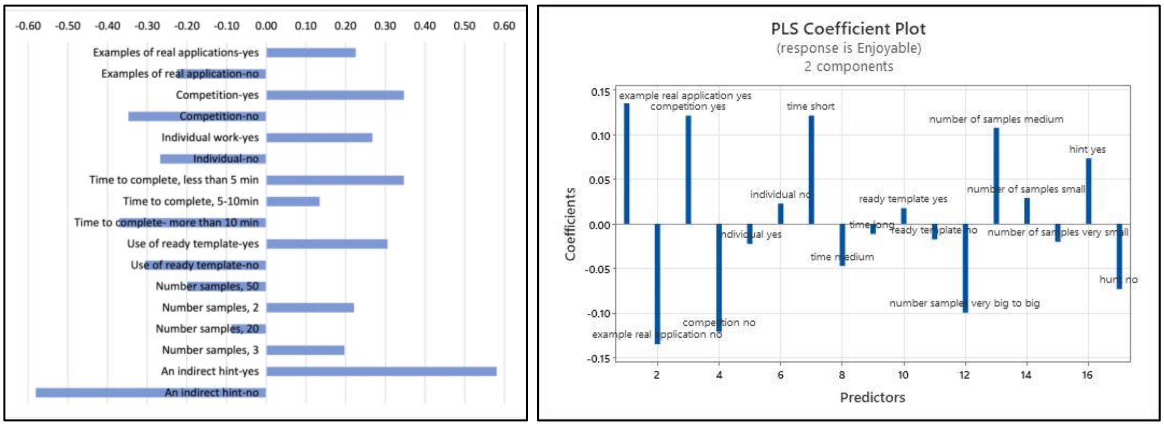

Figure 4. Left: PLS coefficient plot with average values of the responses for all indicators. Right: PLS coefficient plot with responses for "enjoyable"

6 CONCLUSIONS

The created active learning module based on integration of thematic learning in the introductory part, activity learning based on Kansei Engineering methodology leading to a project involves students to explore product characteristics from different perspectives and to "play" by manual clustering a big sample of products from the same domain according to different criteria. The theme "what the product characteristics are" was extended and connected with other relevant and related topics leading to interesting networks with other discipline. The presentations introduce product design, the product to be studied, and technical, less technical, and non-technical solutions. A solid understanding of basic design elements of a product gives students the ability to look at the product from much broader standpoints such as the environment in which it is used, the way it is used, and the design idea being by practicing the creation of items/categories matrix, the Affinity Diagram Method (KJ Method), and the extraction and grouping of Kansei words before stepping into the assessment of the product by the Kansei scale created by them. It carefully considers how students can gradually learn from activity to activity leading to a design project. The learning module differs from the existing ones in the pre-project phase as the assignment of the project is in line with preceded by series of activities, connecting it to the whole content of the module. This will help students later uncover and understand why certain design decisions are made. The proposed learning module uses many and various tools

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and incorporates valuable pedagogical qualities and features of design pedagogy that would be beneficial to students and teachers.

REFERENCES

Academic Practice Department (2019), *Module evaluation: A Brief Guide to Good Practice for Module Leaders*, Birmingham City University. Retrieved from https://bit.ly/36VkgiY

Adnan, H. and Redzuan, F. (2016), "Evaluating students' emotional response in video-based learning using Kansei Engineering", 2016 *4th International Conference on User Science and Engineering (i-USEr)*, Melaka, Malaysia, August 23-25, 2016, IEEE, pp. 237-242. https://doi.org/10.1109/IUSER.2016.7857967

Chuah, K.M., Chen, C.J. and Teh, C.S. (2008), "Kansei Engineering concept in instructional design. A novel perspective in guiding the design of instructional materials", *Fifth International Cyberspace Conference on Ergonomics (CybErg'08)*, Kuching, Malaysia, pp. 37-48.

Drew, V. and Mackie, L. (2011), "Extending the constructs of active learning: Implications for teachers' pedagogy and practice", *The Curriculum Journal*, Vol. 22 No. 4, pp. 451-467. https://doi.org/10.1080/09585176.2011.627204

Herro, D. and Quigley, C. (2016), "Innovating with STEAM in middle school classrooms: Remixing education", *On the Horizon*, Vol. 24 No. 3, pp. 190-204. https://doi.org/10.1108/OTH-03- 2016-0008

Hj Mohd. Naim, N.F. (2022), "The Pragmatic Idea of HCI Notion and KE Approach in Video Mobile Learning", *Proceedings of Sixth International Congress on Information and Communication Technology (ICICT 2021)*, London, UK, Springer, Singapore, pp. 367-376. https://doi.org/10.1007/978-981-16-2102-4_34

Ismail, N.N.N.N. and Lokman, A.M. (2020), "Kansei engineering implementation in web-based systems: A review study", *International Conference on Kansei Engineering and Emotion Research*, Tokyo, Japan, September 7-9, 2020, Springer, Singapore, pp. 66-76. https://doi.org/10.1007/978-981-15-7801-4_7

Ito, H. and Kawazoe, N. (2015), "Active learning for creating innovators: Employability skills beyond industrial needs", *International Journal of Higher Education*, Vol. 4 No. 2, pp. 81-91. http://doi.org/10.5430/ijhe.v4n2p81

Kawakita, J. (1991), *The Original KJ Method*, Kawakita Research Institute, Tokyo.

Khairuddin, A-N.A., Redzuan, F. and Daud, N.A. (2018), "Evaluating students' emotional response in augmented reality-based mobile learning using Kansei Engineering", *International Conference on User Science and Engineering*, Puchong, Malaysia, August 28-30, 2018, Springer, Singapore, pp. 79-89. https://doi.org/10.1007/978-981-13-1628-9_8

Kolodner, J.L., Camp, P.J., Crismond, D., Fasse, B., Gray, J., Holbrook, J., Puntambekar, S. and Ryan, M. (2003), "Problem-based learning meets case-based reasoning in the middle-school science classroom: Putting learning by design (tm) into practice", *The Journal of the Learning Sciences*, Vol. 12 No. 4, pp. 495-547. https://doi.org/10.1207/S15327809JLS1204_2

Martinez, M. and McGrath, D. (2014), *Deeper Learning: How Eight Innovative Public Schools are Transforming Education in the Twenty-First Century*, The New Press, New York.

Nagamachi, M. (Ed.) (2016), *Kansei/Affective Engineering*. CRC Press, Boca Raton, Florida.

Plazaola, I.F., Millán, C.L., Aviñó, A.M. and Morera, M.P. (2016), "Architectural educational experience in Kansei", *Journal of Civil Engineering and Architecture*, Vol. 10, pp. 131-138. https://doi.org/10.17265/1934-7359/2016.02.001

Ramachandiran, C.R. and Jomhari, N. (2018), "Virtual agent design factors for the 21st century learners: A Kansei approach", *International Conference on Kansei Engineering and Emotion Research*, Kuching, Malaysia, March 19-22, 2018, Springer, Singapore, pp. 73-82. https://doi.org/10.1007/978-981-10-8612-0_9

Razumowsky, A. (2021), "Kansei — learning: Emotional writing work on programming lectures", *XXII International Scientific Conference Energy Management of Municipal Facilities and Sustainable Energy Technologies (EMMFT-2020)*, Voronezh, Russia, December 8-10, 2020, EDP Sciences, Les Ulis, France, Vol. 244:11031. https://doi.org/10.1051/e3sconf/202124411031

Retnawati, H., Munadi, S., Arlinwibowo, J., Wulandari, N.F. and Sulistyaningsih, E. (2017), "Teachers' difficulties in implementing thematic teaching and learning in elementary schools", *The New Educational Review*, Vol. 48, pp. 201-212. https://doi.org/10.15804/tner.2017.48.2.16

Shoemaker, B.J.E. (1991), "Education 2000 integrated curriculum", *The Phi Delta Kappan*, Vol. 72 No. 10, pp. 793-797.

Sugimoto, A. and da Silva, T.L.K. (2014), "O emprego da Engenharia Kansei no desenvolvimento de materiais de aprendizagem", *11º Congresso Brasileiro de Pesquisa e Desenvolvimento em Design*, Gramado, Brazil, September 29-October 2, 2014, Blucher Design Proceedings. https://doi.org/10.5151/designpro-ped-01220

Varun, A. (2014), "Thematic approach for effective communication in ECCE", *International Journal of Education and Psychological Research*, Vol. 3 No. 3, pp. 49-51.

https://doi.org/10.1017/pds.2023.22 Published online by Cambridge University Press