

# THE REDESIGN STUDIO: AN INTENSIVE EVIDENCE-BASED APPROACH FOR IDEATING PRODUCT AND UX/UI IMPROVEMENTS

Owain PEDGLEY and Bahar ŞENER

Department of Industrial Design, Middle East Technical University, Turkey

## ABSTRACT

This paper describes a six-week design studio that set out to make ‘redesign’ an educationally rewarding activity, whilst developing students’ skills in evidence-based designing. Final year industrial design undergraduates chose a personally owned household electrical or electronic product that they considered in need of improving or updating. The redesign studio guided students through five consecutive stages of briefings, activities, and critiques: (i) product anatomy analysis and part labelling, (ii) market analysis and market segmentation charts, (iii) hands-on peer contributed user experience (UX) evaluation, (iv) strategies for product improvement, and (v) design proposals. The educational aims of each stage are presented, with particular attention to the UX programme evaluation stage, where students were supplied with a special UX evaluation worksheet to accelerate their comprehension of UX terms and assist the collection and analysis of product evaluations. The results of a survey to gather students’ views on the strengths and weaknesses of the redesign studio are also presented. Students gave overwhelmingly positive feedback, praising the closeness of the studio to ‘real world’ design practice. Their greatest challenge was time management: having to deal with the new experience of a high-intensity studio where they could not afford to ideate for excessively long periods or to procrastinate at any stage. The redesign studio is suggested to be a fruitful model for design instructors to adopt and modify in their own institutions for market-focused design briefs where rationalized incremental improvements are sought, rather than radical innovations.

*Keywords: Product design, industrial design, redesign, evidence-based design, UX/UI*

## 1 INTRODUCTION

Industrial design undergraduates are frequently given design briefs that are open in scope, allowing relatively free exploration of scenarios, products, services, mobile apps, and related systems that will be valuable and relevant to individuals and society in the near or farther future. The pursuit of innovative solutions is often an important criterion for design education. Rather less often, students are tasked with taking an existing product and lifting its specifications in one or more ways. Such projects, though seemingly mundane, represent a large amount of what professional designers do: moreover, they focus the mind on a product’s physical and digital controls, styling, CMF (colours, materials, finishes) and graphics, and purposefully avoid changes in underlying product typology or morphology.

The work presented in this paper is a studio implementation of user-centred research and design, where industrial design undergraduates at Middle East Technical University were given the task to design the ‘next generation’ version of a small electrical or electronic household product that they owned and used at home. Entirely manual products were not suitable, nor were products that were very old or antique. Personal products (e.g., electric toothbrush, epilator, hair curler) were also not allowed, since they would be inappropriate for classmates to use and evaluate. Two emphases were made in the studio. The first was on redesign: students were taken through a journey of market analysis, user research, design prioritization, ideation, concept development, and product detailing, all centred on taking their existing product and replacing it with a newer version. The second emphasis was on generating an extensive evidence base for design decisions, counteracting temptations to rely on intuition or personal preferences. On completion of the studio, students’ final design proposals were expected to be suited to their market sector in 12-18 months’ time.

## 1.1 Orientation of UI, UX and related human factors terminology

Central to the redesign studio was a need for students to be savvy about the meaning and usage of the human factors / ergonomics terms ‘user interface’ (UI) and ‘user experience’ (UX), especially in the current era of product-service system (PSS) design, where physical (e.g., materialized product) and digital (e.g., mobile application) solutions are developed concurrently. At the initial briefing of the studio, students were introduced to the terms and made aware of the manipulability of their application. Industry trends have seen the emergence of UX/UI Designers and UxD (User Experience Design) as a field of work, but very often the main responsibility of these positions is to support mobile app design. The phrase “working in UX” has become practically synonymous with service design realized through digital platforms. These examples served to illustrate how the original conception of the terms UX and UI has become distorted and narrowed. Design educators undoubtedly have a responsibility to rise above trendy usage and at least make students aware of the degeneration of terminology [1]. To this end, the redesign studio instilled in students a reminder that UX and UI are indispensable terms that are not the preserve of mobile app design.

An explanation was given that all materialized products intended for interaction with somebody possess a user interface. At its heart, the UI is the means of accessing functionality. The UI can be no more complex than a handle on a jug that affords grasping and picking up. It can be the combination of controls, displays and other multisensorial feedback on a music synthesizer. Or, in the case of products with a voice user interface (VUI), it is the bridge between a spoken request and a confirmed output or command. A mobile app has a UI, and the use of that UI results in a UX, which all going well is close to the UX that the designer intended. But the mobile app and the process leading to its creation are not in themselves UX/UI. In proper terms, a mobile app is a particular type of graphical user interface (GUI). Having explained principles of UI to students, attention was turned to UX. Donald Norman [2] was introduced as the originator of the term UX, principally because in his view the practices of human-machine interface (HMI) design were too much concerned with usability testing and did not catch the breadth of experiences (or needs) that somebody may have with a system beyond usability. At this point, students were presented with Anderson’s hierarchy of needs [3] as well as Hassenzahl’s distinctions between pragmatic (useful) and hedonic (enriching) user needs [4]. In liberal interpretations, UX is regarded as a catchment phrase that defines how well a design fits to the people using or encountering that design, irrespective of whether the design originates from industrial design, interaction design, information design, visual communication design, web design, service design, etc. [5]. A common objective of centring on UX is to improve the lives of people through the products and services that they use [6] and, accordingly, UX is something that can be designed for and evaluated. Students went into the redesign studio having been exposed to these orientation principles.

## 2 THE REDESIGN STUDIO

The redesign studio was a six-week activity carried out with final year industrial design undergraduates (n=35) as part of their 14 ECTS ‘ID401 Industrial Design V’ module in the Fall 2021-22 semester. The module was delivered by a team of six tutors: two full-time faculty members, two part-time professional designer instructors, and two teaching assistants. Owing to the ongoing COVID-19 pandemic, a hybrid delivery was implemented. A total of 12 hours per week was timetabled, comprising eight hours face-to-face and four hours online (using Zoom). To satisfy the 14 ECTS quota, students were advised to contribute approximately 14 hours of self-study per week. The online collaborative application Miro was used to communicate design processes and outcomes between students and tutors.

Students were guided through five consecutive stages of briefings, activities, and critiques, requiring deliverables illustrated in Figure 1. A detailed description of each stage follows. Assessment was made at three points: Preliminary Jury in week 4 (25%), Final Jury in week 6 (50%), and Project Process Portfolio in week 6 (25%). Students chose their own pairs (n=13) or triplets (n=3) to work in. Members of each pair or triplet negotiated amongst themselves to decide on whose personally owned household product they would use for the studio. The following product sectors were represented: upright toaster, coffee maker, turntable, bread machine, hand vacuum cleaner, juicer, electric coffee pot, sandwich toaster, games console controller, iron, blood pressure monitor, hand mixer and air humidifier.

### 2.1 Stage 1: Product anatomy analysis and part labelling

At the first stage, aside from introducing the module, the redesign studio brief, and forming student pairs/triplets, students were instructed to take note of the sector of their chosen product, what the product

does, its manufacturer name, its brand name (if different), and its model number/name. Students took photos of the product and labelled-up its parts with correct terminology.

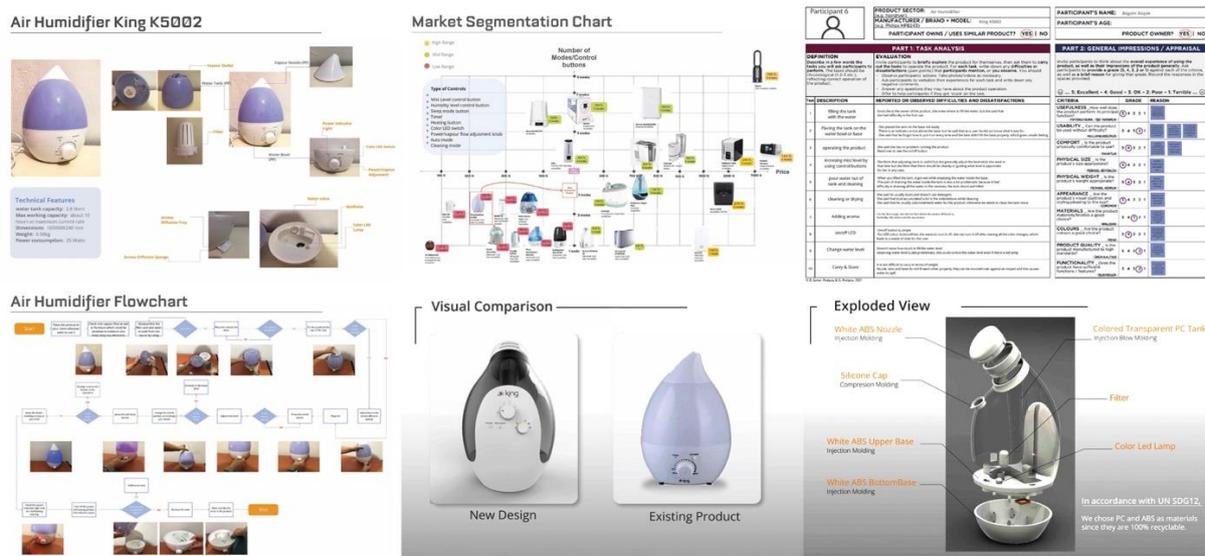


Figure 1. Example deliverables (left to right): labelled product photo, market segmentation chart, completed UX evaluation worksheet, operational flow chart, original product vs. redesign, exploded view (students: Elif Yıldırım, Begüm Küçük)

## 2.2 Stage 2: Market analysis and market segmentation charts

In preparation for the second stage, a briefing was given on techniques for market analysis. Students researched what the main points of differentiation were for their product sector and uncovered example products representing entry-level, mid-range, and high-end segments. These examples were then plotted to create market segmentation charts. The x-axis of the charts was always retail price, but the y-axis was chosen by students based on criteria relevant to their product sector. The existing product for redesign was requested to be highlighted at its (x,y) position on the chart. At this point, students were reminded that they were not permitted to propose a redesign that moved their product dramatically from its current market segment. For example, an entry-level product could not become high-end, but it might be raised closer to mid-range; a high-end product would not be downgraded.

## 2.3 Stage 3: Hands-on peer contributed UX evaluation

Stage 3 provided students with a rich data set from which they could decide how to improve their existing product through redesign. The stage commenced with a class briefing, entitled “What is UX evaluation of products?”, which built on the initial briefing of UX/UI terminology by focusing on the specific topics of UX testing, appraisals, and data analysis. The principles of task analysis, as step-by-step evaluation of product operation, were contrasted with general impression and perceived quality appraisals. Tools to generate UX evaluation data were introduced (e.g., observation, interviews, questionnaires, focus groups, self-reports, diaries for longitudinal use, etc.). Also, the kinds of data that can be collected were highlighted (e.g., measured vs. perceived, quantitative vs. qualitative, fixed criteria (e.g., scales) vs. open-ended (e.g., free text), small vs. large sample groups).

Students were supplied with a bespoke UX evaluation worksheet (Figure 2) designed to accelerate their comprehension of UX terms and give practice in collecting and analysing qualitative and quantitative product evaluations. The worksheet required a combination of self-reporting and observation, providing spaces for product owners to systematically record the results of classmates’ tests of their product. Part 1 of the worksheet was dedicated to task analysis. It required observation, interviewing, and videoing during the main steps of product operation, with the aim to capture difficulties or dissatisfactions. Part 2 of the worksheet was dedicated to general impressions / appraisal. It listed and defined ten common product evaluation criteria to be graded on a five-point Likert scale (usefulness, usability, comfort, physical size, physical weight, appearance, materials, colours, product quality, functionality). A translation for the local language was included to help with students’ comprehension of the criteria.

A briefing on research ethics, codes of practice and informed consent was given, so that students were aware of necessary procedures for conducting user research. Product owners were reminded to be very careful not to ‘lead’ participants to known problems, to share their personal judgements or opinions, or to otherwise bias the data. Their role during the UX evaluation was to be helpful but objective, so that participants could independently form their own judgements and opinions. Therefore, pair and triplet members were instructed to be physically present next to their participants during the evaluations, writing down responses and observations on the worksheet, answering questions, and giving impartial advice as necessary. Before the session started, pair/triplet members were reminded that they should:

- explain what the product is / what it does.
- show where the product features / controls are located using the correct product terminology.
- highlight any potential safety dangers (e.g., moving parts, hot parts) that should be avoided or handled carefully.
- pay attention to hygiene control due to COVID-19 (e.g., provide hand sanitizer and clean the product between evaluations).

Because of time constraints and restrictions on working with third parties, the UX evaluation was made with a small sample size (minimum six people): the product owner, the pair-triplet mate(s), and four other classmates. Evaluations were carried out one participant at a time. The small sample size had no negative impact on the educational experience or learning objectives. When completed, the worksheet formed an evidence base of pain points during product usage as well as positive and negative appraisals based on UX criteria.

INDUSTRIAL DESIGN STUDIO		PRODUCT SECTOR: (e.g. hairdryer) MANUFACTURER / BRAND + MODEL: (e.g. Philips HP8243)		PARTICIPANT OWNS / USES SIMILAR PRODUCT? YES   NO			PARTICIPANT'S NAME:		
							PARTICIPANT'S AGE:		
							PRODUCT OWNER? YES   NO		
PART 1: TASK ANALYSIS				PART 2: GENERAL IMPRESSIONS / APPRAISAL					
<b>DEFINITION</b> Describe in a few words the tasks you will ask participants to perform. The tasks should be chronological (1-2-3 etc.), reflecting correct operation of the product.		<b>EVALUATION</b> Invite participants to briefly explore the product for themselves, then ask them to carry out the tasks to operate the product. For each task, write-down any difficulties or dissatisfactions (pain points) that participants mention, or you observe. You should: • Observe participants' actions. Take photos/videos as necessary. • Ask participants to verbalize their experiences for each task and write down any negative comments. • Answer any questions they may have about the product operation. • Offer to help participants if they get 'stuck' on the task.		Invite participants to think about the overall experience of using the product, as well as their impressions of the product generally. Ask participants to provide a grade (5, 4, 3, 2 or 1) against each of the criteria, as well as a brief reason for giving that grade. Record the responses in the spaces provided.  😊 ... 5: Excellent - 4: Good - 3: OK - 2: Poor - 1: Terrible ... 😞					
Task	DESCRIPTION	REPORTED OR OBSERVED DIFFICULTIES AND DISSATISFACTIONS		CRITERIA	GRADE	REASON			
1				USEFULNESS _ How well does the product perform its principal function?	5 4 3 2 1				
2				USABILITY _ Can the product be used without difficulty?	5 4 3 2 1				
3				COMFORT _ Is the product physically comfortable to use?	5 4 3 2 1				
4				PHYSICAL SIZE _ Is the product's size appropriate?	5 4 3 2 1				
5				PHYSICAL WEIGHT _ Is the product's weight appropriate?	5 4 3 2 1				
6				APPEARANCE _ Are the product's visual qualities and styling pleasing to the eye?	5 4 3 2 1				
7				MATERIALS _ Are the product materials/finishes a good choice?	5 4 3 2 1				
8				COLOURS _ Are the product colours a good choice?	5 4 3 2 1				
9				PRODUCT QUALITY _ Is the product manufactured to high standards?	5 4 3 2 1				
10				FUNCTIONALITY _ Does the product have sufficient functions / features?	5 4 3 2 1				

Figure 2. Bespoke UX evaluation worksheet

## 2.4 Stage 4: Strategies for product improvement

Stage 4 comprised the bridge between the UX research and the generation of redesign proposals. Several briefings were given to students at this stage, including how to analyse UX evaluation data, generate results, reach conclusions and communicate the most important points using infographics. They were instructed to create operational flow charts to visualize the product operation and map associated pain points. A handout on ‘ways to improve products’ was provided to students, as a lens through which to examine their UX research. Additionally, it was important that students’ redesigns would be suitable for 21<sup>st</sup> century sustainability goals. To this end, factsheets on the United Nations Sustainable Development Goal 12 (Responsible Consumption and Production) were provided to students [7]. They were asked to reflect on ways in which the goal could be relevant to their redesign, as a major factor or a supportive

issue. From this point onwards, students were able to explain priority areas to improve their current product. They also referred to aspirational specifications of close competitor products, previously plotted on their market segmentation charts.

## 2.5 Stage 5: Design proposals

At this final stage, students generated design ideas and sketched product solutions in response to the headline results from Stage 4. Pair/triplet members managed their own ideation process as a combination of individual and group working. Students were reminded to be mindful during their ideation about the dynamics between cost (to manufacture), retail price (to purchase) and value (a qualitative judgement, concerning how much people are prepared to pay). They were not expected to know the exact cost of making improvements to their product, but were expected to be sensitive to the issue, making reasonable arguments based on knowledge of the product sector. The segmentation charts were very useful in this regard, forming a reference point for what can and cannot be considered reasonable around the targeted (x,y) position for the redesign. Students were also advised about generational evolution of products. When comparing their redesign with the existing product, there should be a 'family resemblance'. This focused students' minds on brand identity and product styling/semantics. Finally, students were instructed to use only existing or just-about-to-be-commercialized technologies and that their final proposals should be detailed for manufacture and assembly in specific materials, using 3D CAD programs such as Rhino and Fusion. All the studio assessments were made during Stage 5, which covered the final three weeks of the studio.

## 3 FEEDBACK AND DISCUSSION

An online survey completed by all students (n=35) one week after completing the redesign studio revealed areas of success and suggestions for improvement. The survey had ten questions in total. All questions were prepared bilingually (English and Turkish) to aid students' comprehension. Questions 1-9 required students to express their level of agreement or disagreement with positively phrased statements linked to experiences during the studio. A five-point Likert scale was used with the descriptors 'strongly agree', 'agree', 'neutral', 'disagree', and 'strongly disagree'. Figure 3 contains the results, with all figures expressed as a percentage of the n=35 sample. The mean result across questions Q1-Q9 was extremely encouraging: 80% of students either strongly agreed or agreed with the statements, whilst only 5% disagreed or strongly disagreed. Overall, students expressed appreciation of the redesign studio, whilst their responses confirmed that the intended learning outcomes related to both the worksheet and the studio had been achieved. Certainly, students' attention to UX/UI in their design proposals was elevated and competent, suggesting the worksheet had been effective.

The final question (Q10) was a free text question: "Please provide any comments – strengths and/or weaknesses – to improve the UX Evaluation Worksheet and/or the 'Redesign Studio' generally." The answers were analysed using an iterative free coding process. The most prominent feedback (n=7) for the UX evaluation worksheet related to part 2 (general impression). Most students found the numerical scale very helpful, since it easily led to defining a general evaluation result for each criterion. It also formed a quick reference for ideation, to ensure that new design ideas were grounded in the researched (rather than fictional) priority needs and problems. Students provided praise but also constructive criticism about the worksheet in general. One student wrote, "*the worksheet really helped me to visualize the UX process. I will try to use a sheet similar to this on my next projects!*" Another stated, "*the worksheet can be improved to produce less visual and cognitive stress when trying to follow it in a hectic testing phase*". Several students (n=6) mentioned missing information that could be added to the worksheet to enrich its content suitable for ideation, e.g., ergonomic measurements, placement for photos/videos, division between basic and advanced task analysis, memorable comments, and space for multiple problems/issues at each step of operation. These suggestions have been collated and will be used to improve the next version of the worksheet, which will be a digital rather than printed version.

Two prominent themes were found amongst the feedback on the redesign studio as a whole: its duration and its closeness to real-world commercial practice. Among students mentioning the duration (n=13), most thought that six weeks was too short. This duration was set knowing that it would allow sufficient time to complete the work satisfactorily. However, the main issue for students was the unfamiliarity of such a tight and intensive studio. They faced difficulties in adapting to a different working style compared with longer and more relaxed projects in early years. The short duration was necessary to replicate the feel of a real-world commercial practice, which ironically was students' most appreciated

aspect of the redesign studio (n=12). Two comments were particularly rewarding: “My overall comment is really the best project I’ve ever had. I can’t help but thank you for advancing it in such a way”, and “It was beautiful. We had the opportunity to learn about many different products in a project.”

	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Q1. “Using the worksheet was a useful step in my design process.”	40	54	6	0	0
Q2. “The worksheet was easy to follow and complete.”	37	51	9	3	0
Q3. “Part 1 of the worksheet (task analysis) helped me to systematically describe the correct product operation.”	31	46	17	6	0
Q4. “Part 1 of the worksheet (task analysis) was helpful for recording participants’ reported or observed difficulties and dissatisfactions during product use.”	51	43	6	0	0
Q5. “Using a numerical scale (1-5) for Part 2 of the worksheet (general impressions/appraisal) made data analysis relatively easy.”	43	31	23	3	0
Q6. “I appreciated analysing UX data, collected through the worksheet, both qualitatively and quantitatively.”	43	40	14	3	0
Q7. “The fact that the ‘Next Generation Products’ design brief was close to a ‘real-world’ design challenge was satisfying to me.”	69	23	6	3	0
Q8. “The duration of the ‘Next Generation Products’ project (6 weeks from brief to final jury) was a strength of the project.”	20	23	40	9	9
Q9. “The ‘Next Generation Products’ project enhanced my understanding of UX.”	29	51	17	3	0
MEAN (%)	40	40	15	4	1

Figure 3. Results of post-studio survey

## 4 CONCLUSIONS

The redesign studio clearly helped orient students towards the practices of professional design and the rewards that can come from relatively fast-paced and evidence-driven decision making, rather than over-concentration on early stage imagination, ideation and “what if..?” questions. It also provided students with experience of being creative within a solution space that was more constrained than they were used to: change an existing product rather than innovate from a *tabula rasa*. The redesign studio mirrored professional design practices, regarding intensity (which students found challenging) and decision-making (using primary data on people’s needs and desires). By progressing through the five stages of the studio, students cumulatively strengthened their understanding of the shortfalls of their owned product, reaching a point where they had confidence and evidence to ideate remedies and improvements. Along the way, students were instilled with a mature perspective of UX/UI for physical and digital solutions and got to learn about design issues across many product sectors by attending their peers’ juries.

## REFERENCES

- [1] Joo H. A Study on Understanding of UI and UX and Understanding of Design According to User Interface Change. *International Journal of Applied Engineering Research*, 2017, 9931-9935.
- [2] Norman D. A. *The Design of Everyday Things: Revised and Expanded Edition*, 2013 (Basic Books, New York).
- [3] Anderson S. *Seductive Interaction Design: Creating Playful, Fun, and Effective User Experiences*, 2011 (New Riders).
- [4] Hassenzahl M. The Thing and I: Understanding the Relationship between User and Product, in M. Blythe, K. Overbeeke, A. Monk, & P. Wright (Eds.), *Funology – From Usability to Enjoyment*, 2003, pp.31-42 (Kluwer Academic Publishers, Dordrecht).
- [5] Rowland C. *User Experience Design for the Internet of Things: Why It's More than UI and Industrial Design*, 2015 (O’Reilly Media, Inc).
- [6] Kovatcheva E. User Experience Design Models for Internet of Things. *Serdica Journal of Computing*, 2018, 65-82.
- [7] United Nations (2021). Sustainable development goal 12. Available at <https://sdgs.un.org/goals/goal12>.