Generative Design Research for Sustainability: Exemplary Cases for the Adaptation of the EC Guide Tool and the ERM Method

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Abstract

This paper presents the main process of a graduate course entitled 'Generative Design Research for Sustainability' offered in the Department of Industrial Design at Middle East Technical University in the spring semester of 2015/2016 through exemplary design research cases conducted by the graduate students at the doctoral level. These cases focus on the adaptation of the generative tool and the method, namely Experience Chart (EC) Guide tool (Kulaksız, 2016) and Experience Reflection Modelling (ERM) method (Turhan, 2013), in line with the graduate students' particular research topics. First, the paper provides the course objectives, outcomes and process, then, it explains the EC Guide tool and the ERM method to be adapted and implemented within the context of the course. Then, these generative tool and method, and their adaptations are demonstrated through the exemplary cases (i.e. efficient use of working environment in design studios, lighting practices in kitchen environment, and interactive prototyping practice) selected from the submitted assignments considering their quality, originality and comprehensiveness. The main emphasis of this paper is on the adaptation and implementation of the EC Guide tool and the ERM method through providing the experiences, insights and suggestions of the graduate students who are also the co-authors of the paper. Based on that review, major conclusions and findings are presented through comparing and contrasting these cases for the future development of the course.

Keywords: Generative Research Methods and Tools, Sustainable Design Considerations, Design Research, Qualitative Research, Industrial Design

Literature Review

'Generative Design Research for Sustainability' course provides the graduate students with a

basis for a better understanding of generative research approaches in line with design considerations for sustainability such as enabling post-use services including product maintenance, repair, upgrading via product part replacement and/or refurbishment, and understanding local usage patterns and encouraging effective use of resources (e.g. energy, water, etc.) (Turhan & Dogan, 2014). It includes the exploration of current issues in participatory and generative research approaches (Sanders & Stappers, 2014) for integrating sustainable design considerations; the examination of various generative tools and methods for having a better understanding of people's needs, preferences and desires by involving them in design research, and facilitating their active involvement (Martin & Hanington, 2012; Hanington, 2007, 2003; Sanders, 2008; Sanders, Brandt, & Binder, 2010; Sanders & Stappers, 2013); the development and implementation of an activity and/or product oriented design research project incorporating sustainability considerations into these methods and tools; the discussion and presentation of findings and conclusions from the generative design research projects. Throughout this course, the students:

- Understand the current issues in participatory and generative research approaches;
- Examine various generative tools and methods, including the Experience Chart (EC) Guide tool and the Experience Reflection Modelling (ERM) method for design researchers;
- Conduct user observations via the EC Guide with participants on a selected activity and/or product;
- Prepare a research brief integrating sustainable design considerations for the selected activity and/or product;
- Develop and implement EC Guide as a generative research tool;
- Discuss and present findings and conclusions from the EC Guide adaption and implementation;
- Develop, adapt and implement ERM as a generative research method;
- Discuss and present findings and conclusions from the ERM sessions;
- Develop research directions for idea generation phase; and
- Evaluate and present the generative design research process.

Research Methods

This paper is based on the perspectives of various people involved in the course (i.e. graduate students, and two course tutors), and communicates its conclusions and insights through their involvement as the principal and co-authors. The course is offered by two of the co-authors, Doğan and Turhan, who developed the ERM method within the context of Turhan's doctoral thesis (Turhan 2013) and undergraduate design education projects. Similarly, the EC Guide tool was developed by two of the authors, Doğan and Kulaksız, as part of Kulaksız's master's thesis (Kulaksız, 2016). Other authors are the doctoral students and research assistants in the Department of Industrial Design whose final course submissions are presented as exemplary cases in this paper.

Throughout the course, the graduate students adapted and implemented the generative design research tool (i.e. EC Guide) and the method (i.e. ERM) considering their design research topics and related products or/and activities. They integrated these tool and method into their

design research to better understand sustainable design considerations derived from the perspective of potential users, and to develop research directions for idea generation phase. They also recorded their experiences and insights, and shared these with the course participants via presentations and class discussions. These submissions included observational, evaluative and reflective feedback from the graduate students and they are presented in this paper.

Experience Chart Guide for User Observations

The EC Guide is a user observation tool that is particularly developed and assessed within the design education context (Figure 1 & 2). It aims to guide design students while capturing and documenting user observations as part of exploratory research to inspire and inform their early design decisions. It helps them remember and pay attention to important considerations before, during and after the user observations.

The EC Guide (Figure 1 & 2) starts with the *empathy* as a pre-observation stage conducted by the students individually. This is followed by four main stages that are *participant & environment, observations, thinking aloud,* and *memories & dreams* with the involvement of the participant.

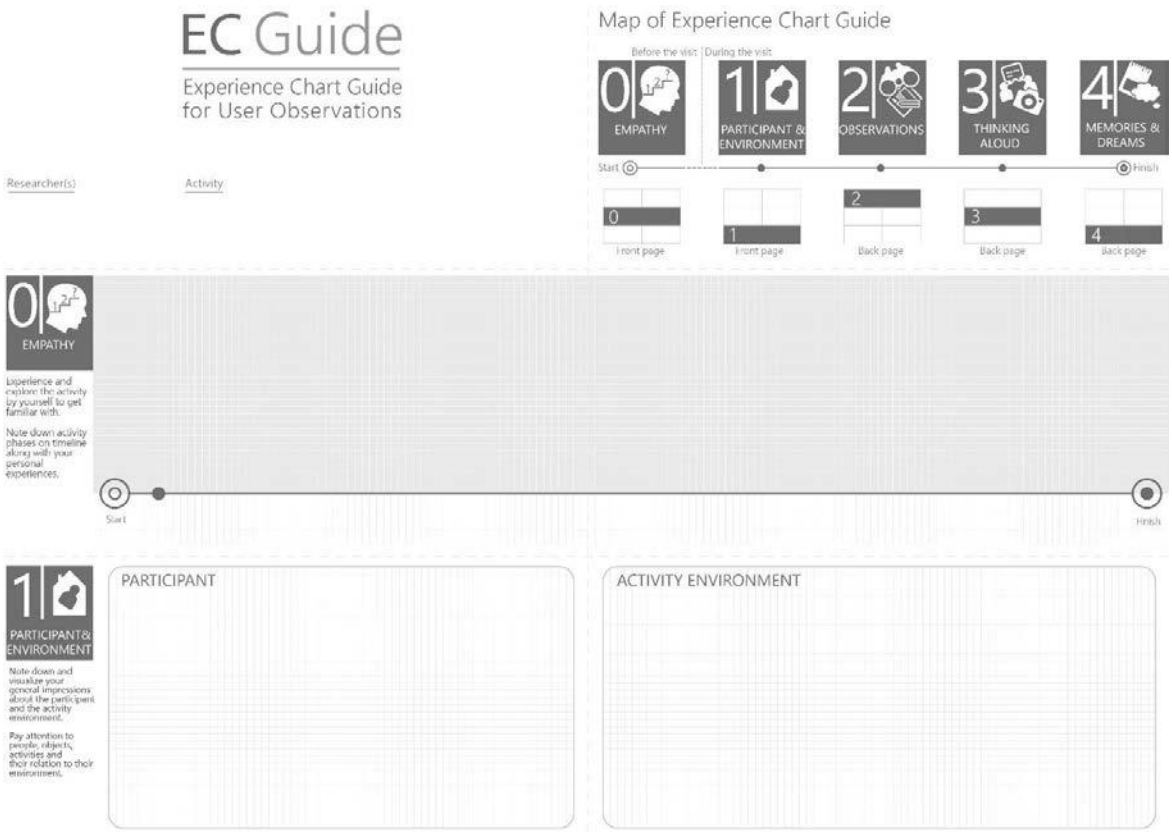

Figure 1. Front page of the EC Guide.

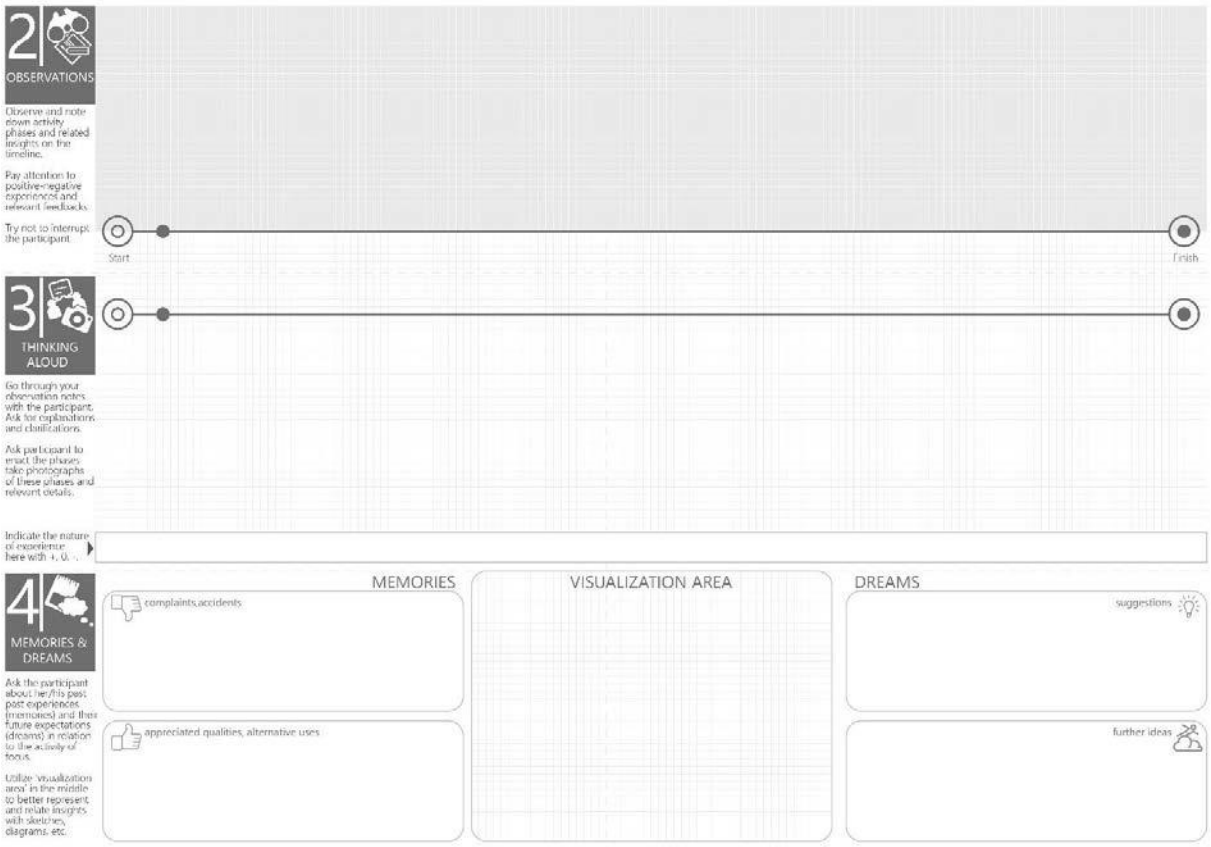

Figure 2. Back page of the EC Guide.

Empathy: The students explore the activity of inquiry to get familiar with it before the user observations, and document their individual experiences. This familiarization enriches their knowledge about the activity, its phases and context, and the related product(s) of focus that would make them more attentive while observing the participants. The students can easily recall their own experiences during the user observation by referring to this part and ask participant her/his opinion about issues that they would remark during their own engagement with the activity.

Participant & Environment: The students document their general impressions about the participants and the activity environment. Although they are flexible about the type of information to seek and express in this stage, they are advised to pay attention to the interaction between people, objects and activities existing in the field of observation. Insights gathered in this part help the students evaluate and analyse the observation findings within its context.

Observations: The students observe their participants while they carry out the activity of inquiry, and document their insights on the timeline provided. They pay attention to and highlight activity phases, perceived experiences of the participants corresponding to these phases, and feedbacks that the participants receive from the activity environment.

Thinking Aloud: The students together with the participants go over the notes documented during the observation to better understand their viewpoint. The students ask for clarifications and explanations to understand the underlying reasons of the participants' activity related behaviours. The students also ask them to demonstrate the activity phases via enacting. By doing so, they are able to take photographs for each activity phase and important details without the concern of disturbing the natural course of the observation.

Memories & Dreams: The students interview the participants about their past experiences (i.e. memories referring to complaints, accidents, appreciated qualities and alternative uses) and future expectations (i.e. dreams referring to suggestions and further ideas) regarding the activity of inquiry. By doing so, they gain more detailed insights from the participants that might be difficult to receive during the previous stages. As the participants just experience the activity of inquiry, it is easier for them to recall their earlier experiences and generate their future expectation by reflecting on the whole process (Sanders & Stappers, 2012).

The students are also provided with a digitally editable EC Poster template as a presentation medium of user observation findings (Figure 3). It has similar characteristics with the EC Guide, and facilitates the communication of insights through a semi-defined layout. Within the content of the course, the students were asked to conduct two user observations via the EC Guide considering their specific research topic, and present their insights in the EC Poster format.

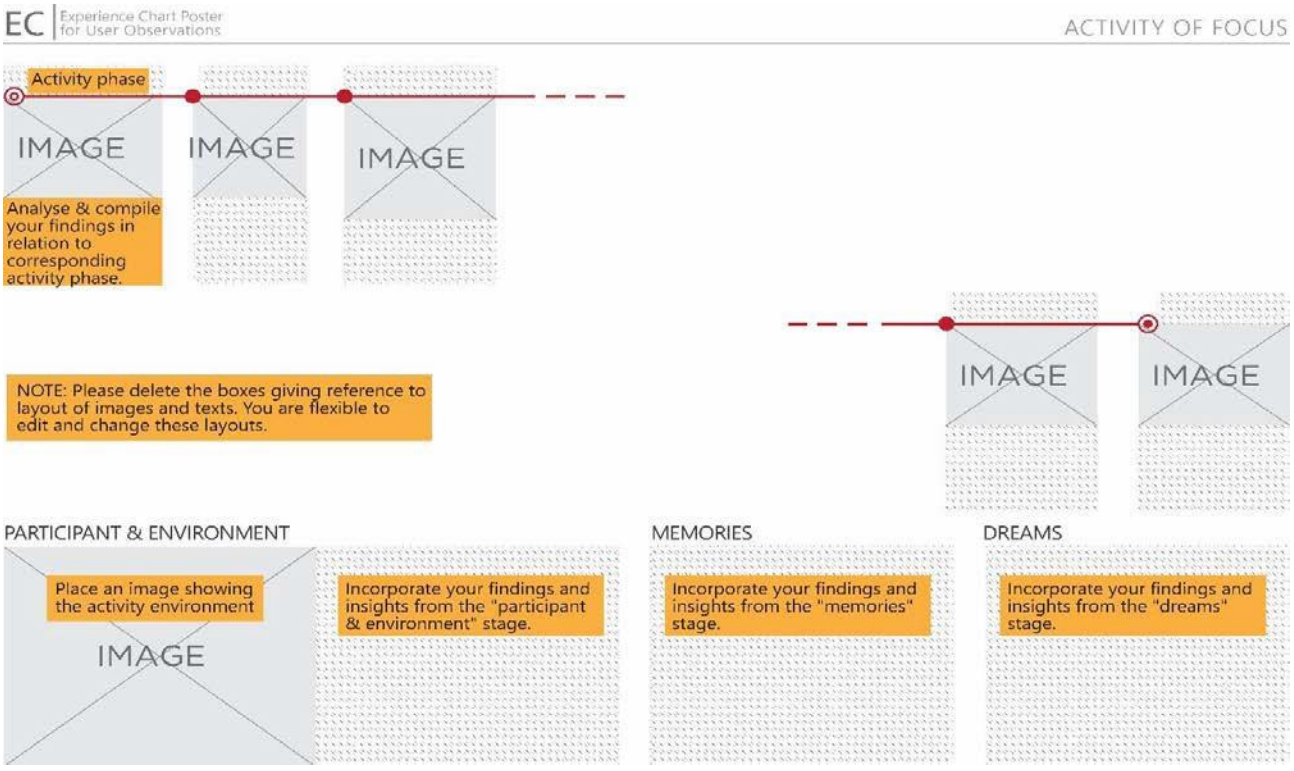

Figure 3. The layout of the EC Poster template.

Experience Chart Guide as a Generative Tool

The graduate students evaluated the EC Guide tool and their experiences with it during user observations, as they were required to develop it as a generative tool for gaining more insights into user needs and preferences for their specific research topic. In order to proceed this process effectively, they needed to think about it step by step from the recruitment of participants, the distribution of the adapted version the EC guide as a generative tool, collecting the filled-out generative tools, and to the analysis and presentation of the findings and insights from this phase.

First, they focused on a specific activity considering the findings from user observations. They were advised to go through the limitations and challenges that they faced during user observations, and highlighted them on the EC guide for further iterations. Based on our class discussions in class, they developed insights, and incorporated these into their generative EC Guide that they would develop.

The EC Guide includes a timeline that has generative research features in terms of its ability to get people involved in the process. For instance, potential participants can easily take notes on this timeline to reflect on and share their experiences. The visualization area in the original guide aims to get feedback from the potential participants. These features can be enriched with other alternative parts for the EC guide in order to prime the participants in the process, thus to provide further insights through engaging them in the process more effectively (i.e. activity phases, positive negative experiences and feedback). The EC Guide as generative research tool may include different interconnected phases some of which can be experienced individually by the participants, whereas some can be facilitated by the involvement of the researcher.

Considering the development of generative tool and the changes that the graduate students embraced, they adapted the layout of the EC Guide and the EC poster template. Besides, they enriched their generative toolkit by including necessary instructions. They also provided a summary of their experiences, insights and suggestions while developing and conducting their generative EC toolkit.

Experience Reflection Modelling

ERM, as a design research method (Figure 4) enables people's involvement in the early stages of the design process to help design researchers better understand people's needs, expectations and preferences regarding an activity and/or product through creating a medium for knowledge transfer (Doğan, Turhan, & Bakırlıoğlu, 2016; Turhan & Doğan 2017, 2014).

Within the context of the course, the students developed a draft ERM toolkit and interview schedule, and evaluated these for further development via focussing on the selected activity of their research area. They used their toolkits and interview schedules for rehearsals to be held during the class. The rehearsals are essential to get familiar with the ERM sessions, understand the difficulties related to the conduct of the sessions, and enable students to assess and further develop their ERM toolkits and interview schedules.

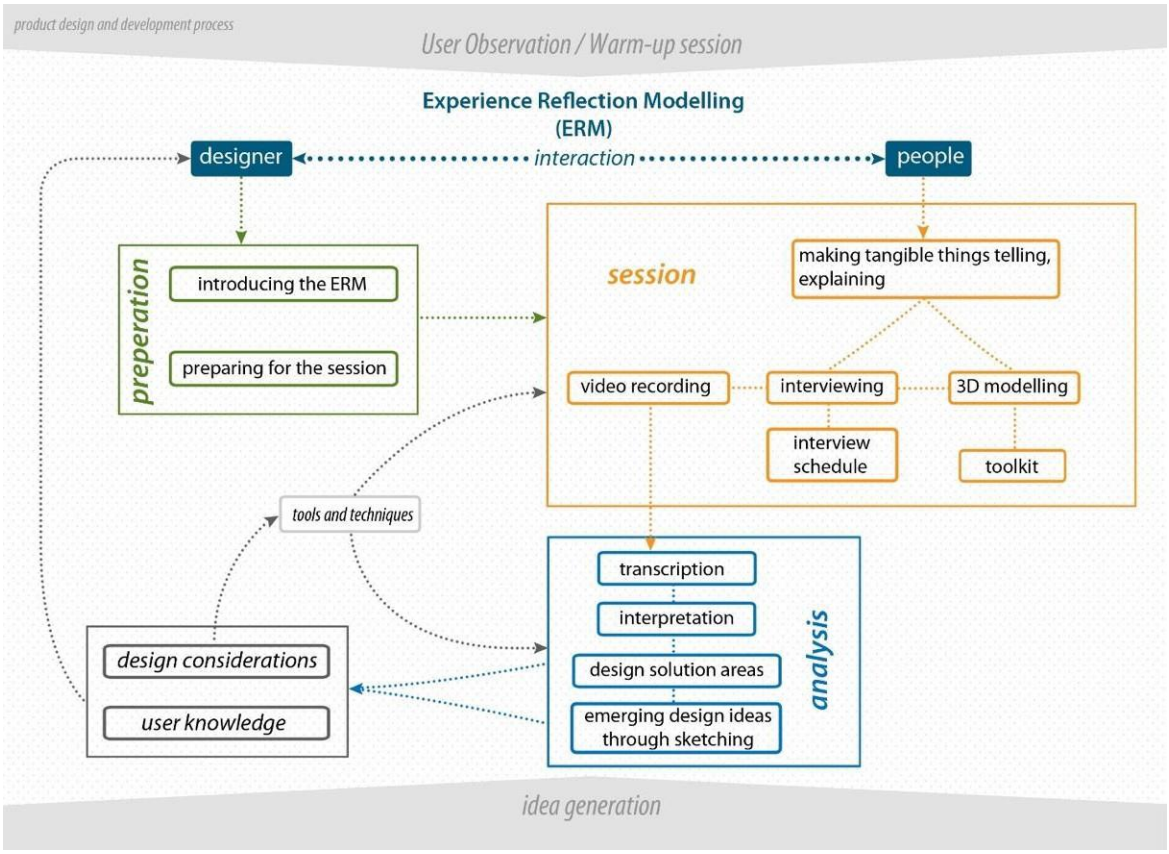

Figure 4. The phases and components of ERM.

Developing the interview schedule: Interview schedule includes brief information for participants, questions related to a lifespan of a product, and questions about additional features and improvements regarding the product. The questions should be developed based on the design considerations in the research brief. The format of the interview schedule should enable the students to easily follow.

Developing the ERM toolkit and the drawing file: An ERM toolkit composes of 2D and 3D parts which have the potential to represent particular components of a product category. Diverse and various parts can be added as much as possible. However, the parts should represent abstract forms, so that the preferences of the participant won't be led by the aesthetic features of the parts. In addition to the pre-defined parts, different materials such as play dough, coloured papers and pens, fabric, wire, etc. can be added to meet the request of the participants. Putty-like adhesives such as Tack-it, Blu-Tack or tapes are used to bring together the parts during the 3D modelling phase. The main focus in the toolkit development is to provide diversity to enable the participants to personalize the 3D model based on their preferences.

Conducting the ERM session: During the sessions, the student asks questions by using the interview schedule, and the participant responds as she/he brings together the components of the toolkit. Asking the reasons of the participant's responses should not be missed, since these would help the student make better interpretations from the ERM analysis phase. The sequence of the

questions may change in line with the responses of the participant. The student should encourage the participant to use the toolkit while responding the questions. The student should not direct the participant while helping the 3D modelling phase. When the participant adds parts to the model and makes changes on the model, the process should be documented for the analysis phase of ERM.

The Adaptation of the EC Guide Tool and the ERM Method

Case 1: Efficient use of Working Environment in Design Studios

In this case, the researcher explored the efficient use of working environment in design studios in terms of model making process involving materials and tools. Their storage, transportation and life-cycle in the design studio environment were observed and analysed related to sustainable considerations such as effective use of materials and environment. Third-year industrial design students, their design studio environment and design project processes were selected to be explored.

The EC Guide as an Observation Tool: The brief of the EC Guide indicates that this tool can be used for a specific product/activity for a short period of time. However, the research in this case contains an environment, a series of activities within a system which are carried out in a long period of time (over a few days), investigating students' attitudes during model making process in the design studio environment.

Due to the time limitation, *observation* stage was completed during the third-year industrial design studio course hours; although, to observe the whole model making process continued at least a week within and/or outside the studio hours. The EC Guide directs researchers to observe activities step by step; however, this case does not consist of these successive steps. After completing the *observation* stage, the researcher and participants came together, and passed over the notes in the *thinking aloud* stage, which provided the researcher with the opportunity to evaluate findings together with the participants. Due to the intermittent nature of activities, to switch between these two stages became harder. In the last stage of the tool; while *memories* part was like a repetition of the *thinking aloud* stage that the participants talked about their old experiences, *dreams* gave them the opportunity to analyse their thoughts and create new ideas. The EC guide was very effective in terms of organizing the observation process. The division of the process into different stages helped the researcher examine the research area from different views.

Figure 5. The EC Poster for one of the user observations.

<u>The EC Guide as a Generative Tool:</u> While developing a generative tool, the EC Guide was adapted and reformed in order to gather insights from the participants. The layout and the content of it were changed, and it would comprise of seven stages including *project definition*, *project process*, *model making process*, *definition of problems* and *suggestions for problems* divided into three: environment, actor and product/system (Figure 6). First and second stages were formed to make participants familiar with the process. Next two stages were asked to participants to explain their model making process and the problems being encountered in this process, and remaining stages aimed to incorporate suggestions into these problems, and their visualisation via quick sketches and diagrams.

Figure 6. Adapted version of the EC Guide as a generative tool for Case 1.

Due to the lack of explanations on the adapted EC guide, the participants could not complete it as planned. Therefore, the adapted EC Guides were collected and revised, and the participants refilled them. It is very significant and critical to make each stage clearer and more descriptive. After the researcher went through the charts, the information gathered was reviewed together with the participants, and the missing parts were clarified. This stage supported the findings, and helped the participants rethink their notes. To arrange and categorize the stages of the activities, and match those with the photographs effectively the EC Poster (Figure 7) was prepared.

This experience is more participatory-oriented, so that every detail needs to be considered carefully. The researchers have no chance to interfere with the process. Making the participants more willing to and comfortable with filling out this toolkit can lead to collecting deeper information. Before the analysing stage, meeting with the participants is important to resolve incoherent parts, and to make every detail clearer.

Figure 7. Adapted EC Poster.

The ERM Method: For the ERM method, the research topic mainly focused on organising the studio environment, model making tools and materials. Prior to the ERM sessions, interview schedule and toolkit were prepared, and a rehearsal session was conducted during the course hours. This process informed the researcher about how the process would work, and helped her/him identify problems and reorganize the process accordingly.

One of the most difficult stages of the ERM method was preparing the toolkit for a design solution which would not exist until now, so the toolkit was developed based on potential design solutions. Therefore, generally various sizes of 2D forms which can be used in developing 3D models were preferred (Figure 8).

Figure 8. The ERM toolkit (left) for Case 1, an example from an outcome of the session (right).

The participants were familiar with the topic, since they attended the first observation stage. The researcher asked the participants to decide on their suggestions for a proper scale, and marked the area on the wall with the paper tape, which became very helpful for the rest of the process. This marked area was utilized for other solutions. The participants tried to find solutions in terms of their past model-making experiences, and the ERM toolkit helped them recall their problems, and express their needs. In addition, the plan of the studio environment was given to the participants in order to foster their imagination, and help them provide their insights and suggestions more effectively.

During the analysis stage, based on the sustainability considerations, including effective use of materials, tools and environment, the insights and themes were arranged and their connections were formed. For the poster presentation, many elements such as photographs, drawings, quotations and graphical representation were used (Figure 9).

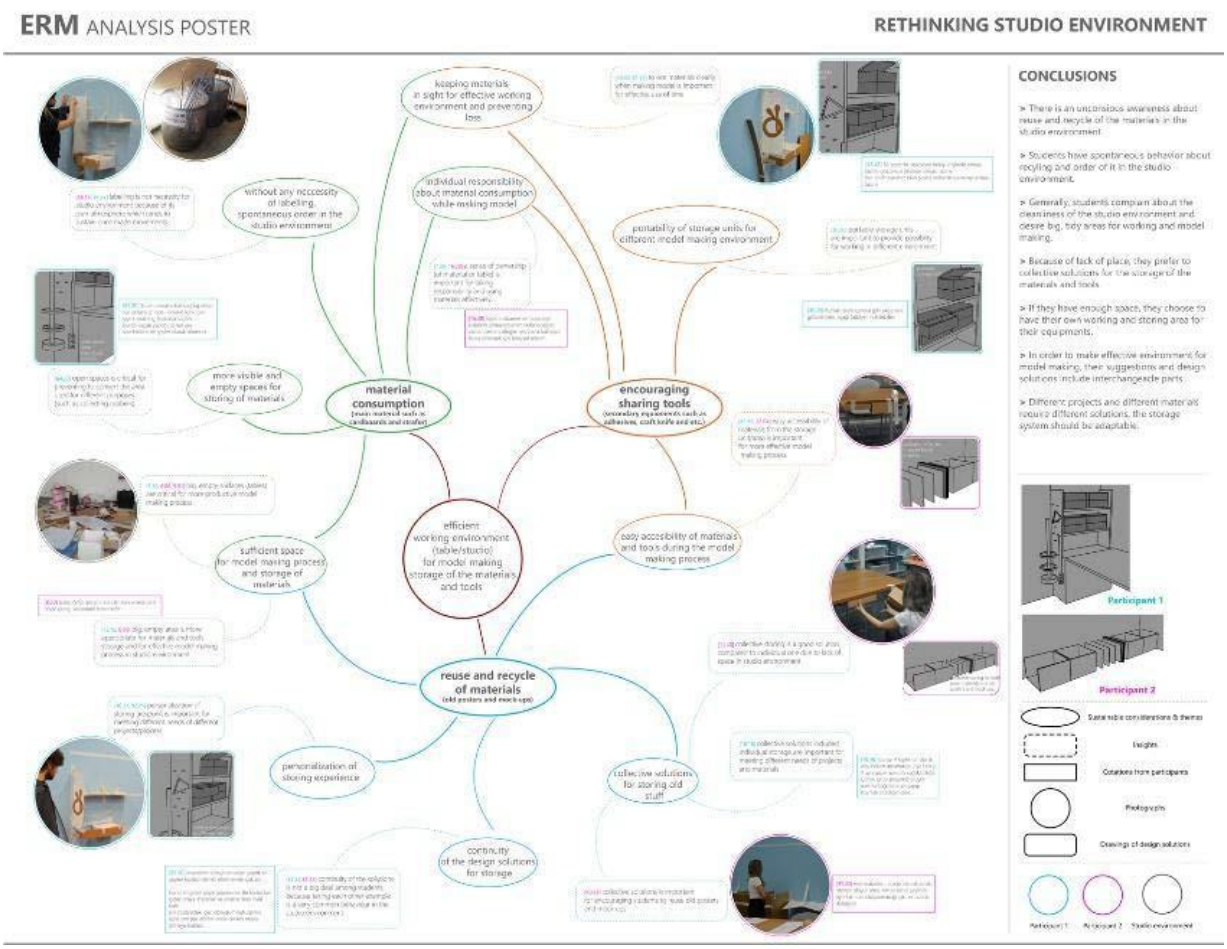

Figure 9. ERM Poster presenting the findings from the sessions.

Case 2: Lighting Practices in Kitchen Environment

The researcher, in this case, explored the lighting practices in kitchen environment to gain insights into the users' diverse needs, experiences, expectations and concerns related to electricity consumption. Participants' use patterns and insights were acquired and analysed in line with the related sustainability considerations including resource effectiveness, clarity of feedback and adaptability to user needs, preferences and use behaviours.

The EC Guide as an Observation tool: The researcher used the EC Guide as an observation tool in two diverse households while participants performing activities such as preparing food, serving tea and cleaning dishes. The *empathy* stage of the EC Guide enabled the researcher to recognise the potential interactions and use patterns that need to be further explored through the actual observations, and also to develop probe questions for more detailed participant responses. During *observation* stage, as the main activity continued for a long period of time, the researcher preferred to take photographs without interrupting the activity and explored these further in the following stage. *Thinking aloud* stage complemented the observations, and revealed detailed

information about the participants' concerns and insights that were difficult to receive solely through observations. In *memories and dreams* stage, the data received from the participants was quite detailed, yet often irrelevant to the main focus of the study. In the visualisation area located in this stage, even the researcher tried to encourage the participants to draw, both participants hesitated to visualize as they felt uncomfortable with the quality of their sketches. The design of the EC guide, including interrelated phases, enabled an effective analysis process. The documented data was easily transferred into the EC Poster (Figure 10).

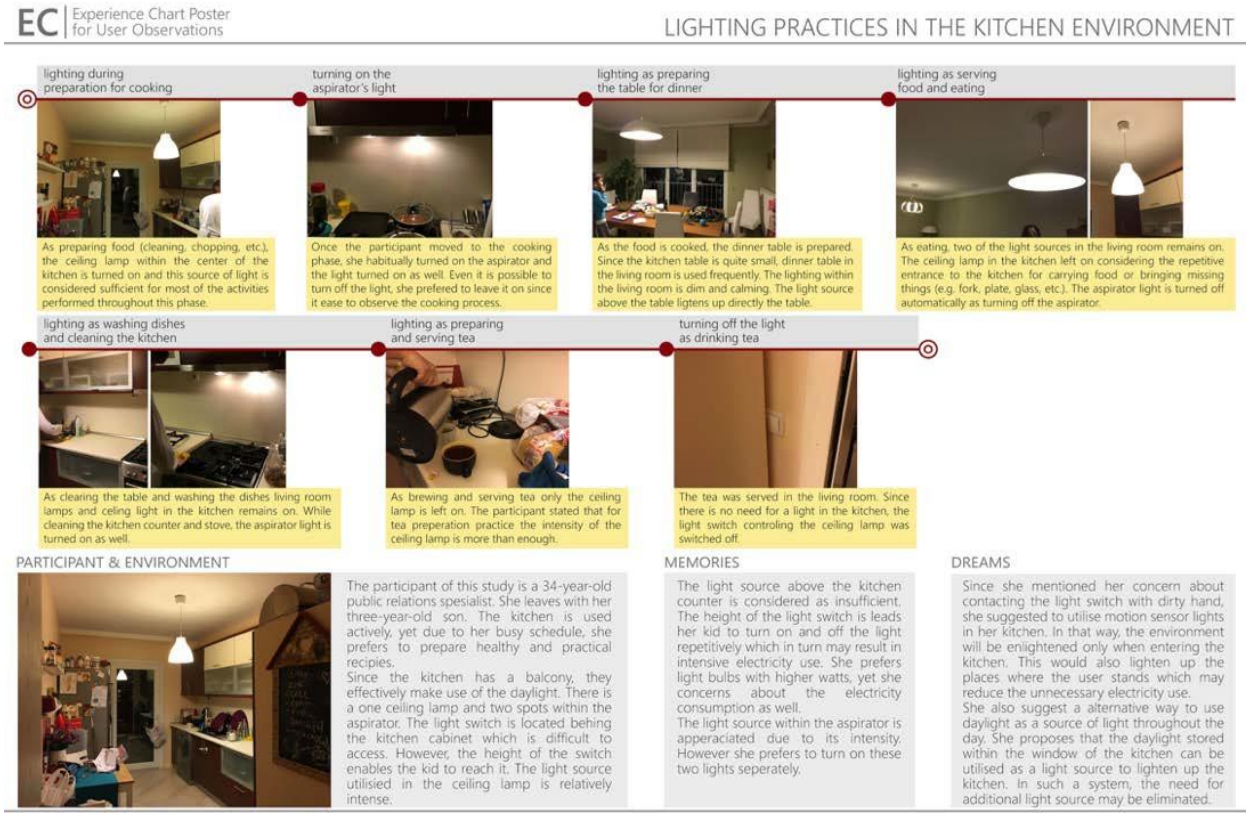

Figure 10. The EC Poster for one of the user observations.

As adapting the EC Guide, documenting the participants' activity patterns and responses simultaneously was often found difficult which might have been supported with voice recording. The incorporation of the EC guide requires some effort from the researcher while facilitating the sessions, yet the received data is quite detailed compared to conventional user observation.

<u>The EC Guide as a Generative tool:</u> As adapting the EC Guide as a generative tool, the researcher reconsidered the main focus of the research and limitations of the previous phase. In that sense, the guide was revised through including new phases (i.e. frequency and duration of use, electricity consumption, etc.) and omitting (i.e. empathy phase) or combining others (e.g. problem areas) to be able to capture the participants' experiences and insights that would be essential for the particular research. She also included a complementary semi-structured interview session to probe into the participants' statements documented on the tool. The adopted

guide was distributed to two participants to be filled out and returned prior to the interview sessions to prepare an interview guideline.

The adopted generative tool has six stages including *use environment, frequency and duration of use, use experience, resource consumption, problem areas* and *design suggestions* (Figure 11). In the *use environment* stage, the participants were asked to take the photographs of the kitchen environment, and note down the number, location and features of the existing light sources.

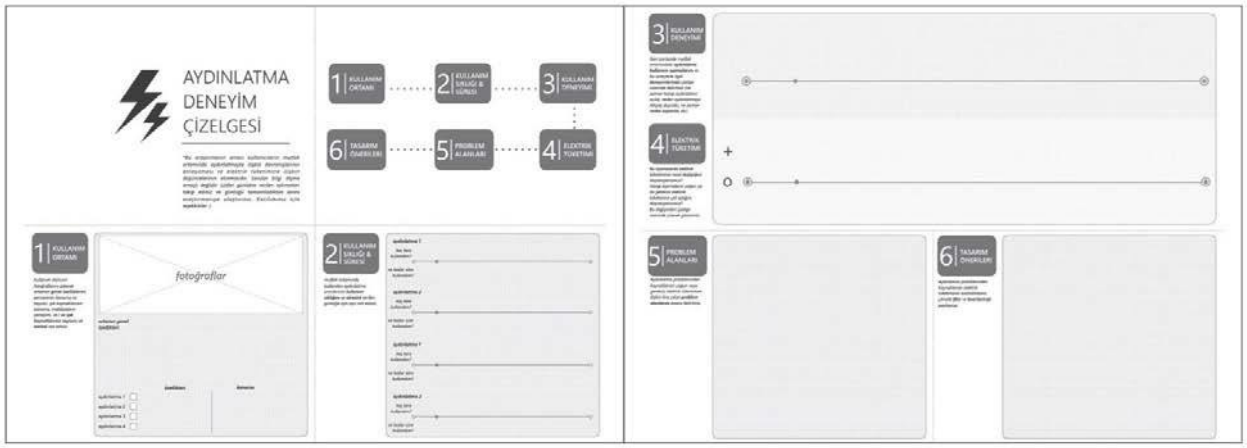

Figure 11. Adapted version of the EC Guide as a generative tool for Case 2.

In the second stage, the participants were asked to track their lighting patterns throughout the day and record the frequency and duration of use on separate timelines provided for each light source. In the *use experience* stage, the lighting use patterns in the kitchen were documented as performing a certain activity (e.g. preparing food). In the *electricity consumption* stage, the participants were asked to visualise the intensive or unnecessary resource use in the related use patterns defined on the previous stage. The aim of this stage was to explore participants' understandings and their perception of resource use rather than evaluating their knowledge. The *problem areas* stage questioned the lighting patterns leading to intensive/unnecessary resource use while the final stage, *design suggestions*, asked for the participants' design suggestions to reduce electricity use resulting from the lighting behaviours.

The EC Poster format was revised to be able to present the findings and insights effectively (Figure 12). The adapted toolkit and interview sessions required some effort from the researcher and the participant, yet, the received data was quite comprehensive.

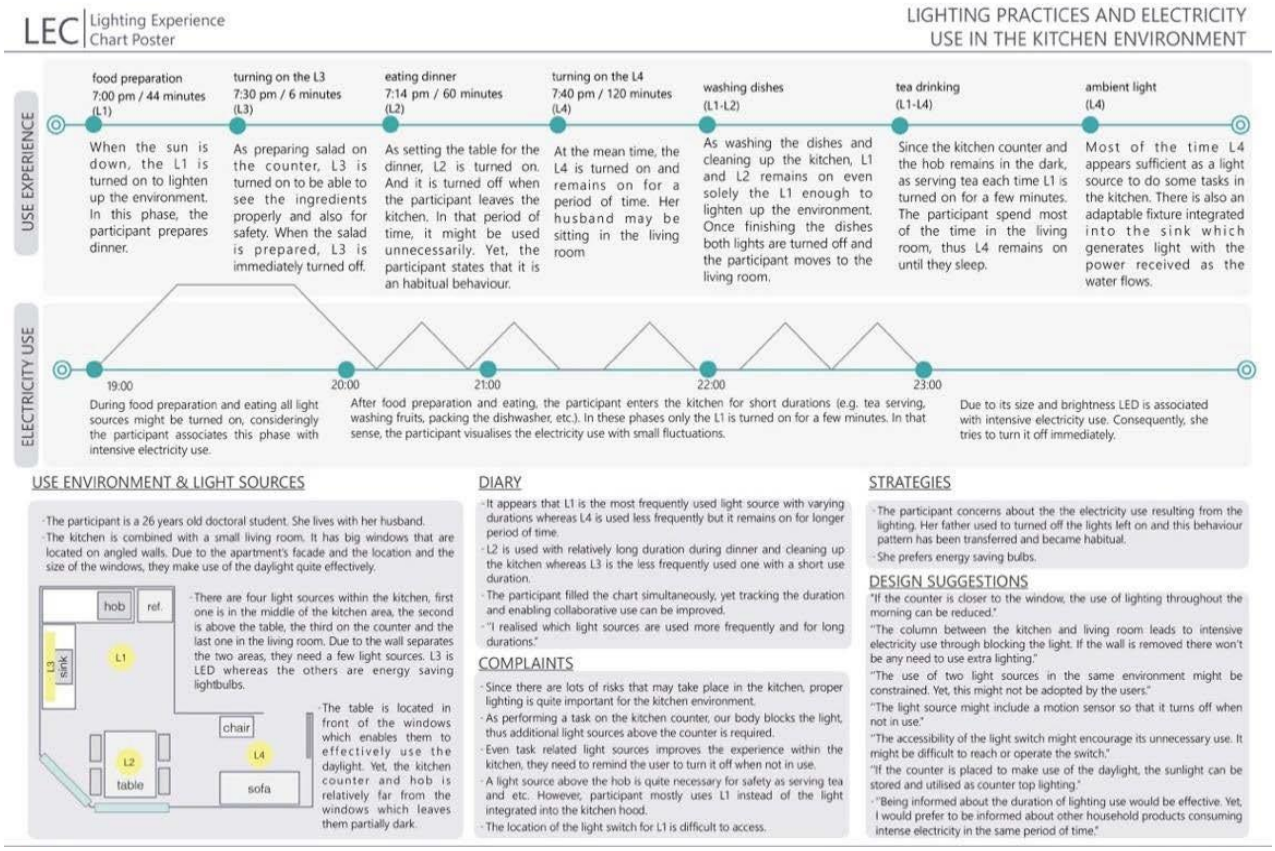

Figure 12. Adapted EC Poster.

The ERM Method: Within the context of the research, ERM was adopted through a scaled model of a kitchen environment and one-to-one model of the light switches. Prior to the sessions, an interview schedule was prepared encompassing use experiences, concerns related to the electricity consumption and such to guide the sessions effectively. The 3D modelling toolkit was prepared including materials such as cardboard parts, coloured pens, play dough, tape, tack-it, acetate, and rope (Figure 13). Through a rehearsal session, the toolkit as well as the guideline was revised (e.g. the ceiling with a grid-like structure to ease hanging lighting units, etc.).

Figure 13. The ERM toolkit (left) for Case 2, an example from an outcome of the session (right).

The sessions were carried out with two participants with the help of another researcher for audio visual recordings. As engaging with the toolkit, the participants used the parts quite effectively and even unexpectedly (Figure 13). For instance, the parts developed for the light sources (i.e. tubular fluorescence lights) were used to support the main structure of the kitchen. The waffle structure walls enabled the participants to create overall environment easily while the grid structure of the ceiling allowed them to manipulate the environment quite effectively.

The video recordings were verbatim transcribed and interpreted to develop sustainability considerations and themes. Later, the findings from the ERM sessions were transferred to a poster through demonstrating the relations between the considerations, themes, insights and images from the ERM sessions with specific time slots (Figure 14).

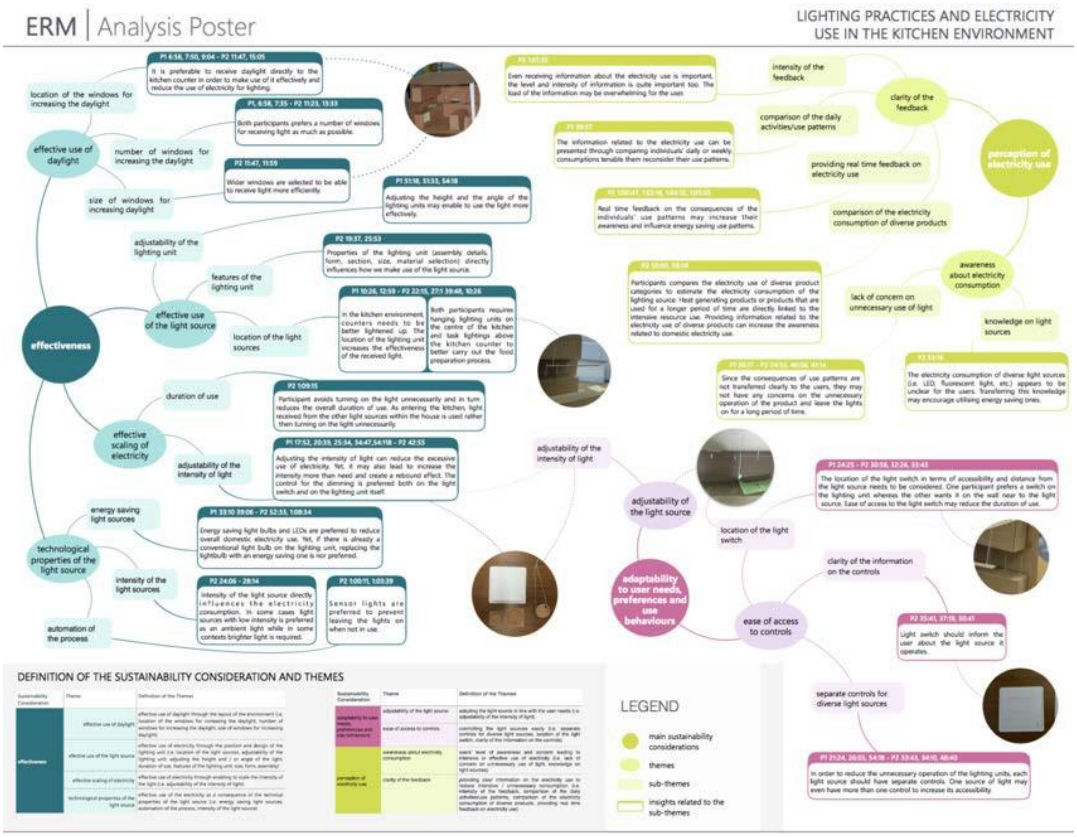

Figure 14. ERM Poster presenting the findings from the sessions

Case 3: Interactive Prototyping Practice

The researcher in this case aimed to investigate skills, knowledge acquisition and storage habits of industrial design students practicing open-source interactive prototyping tools. The structure and the aim of the research were shaped in accordance with the sustainability considerations to gain insights about the causes of material waste during the prototyping activity.

The EC Guide as an Observation tool: The EC Guide was utilized in the study with two participants who were asked to make a simple interactive prototype of a product of their own choice. At the *empathy* stage, the past experiences with the prototyping activity were documented by the researcher to get familiar with the phases in order to develop the questions to be asked in the next stages of the study. At the *Participant & environment* stage, the essential information about the participant and the environment was documented. However, it was challenging for the researcher to execute observing the environment, photograph-taking and question-asking procedures all at once. During the *observation* and *think aloud* stages, most of the observation process went flawlessly in terms of data collection, which provided considerable amount of data. *Memories and dreams* stage was useful for visualising the participants' experiences, expectations, and to summarize all the cons and pros. The elements questioned in dreams section of this stage (i.e. suggestions and further ideas) could be combined into a single area, since it creates some confusion.

The use of the EC Guide for user observations allows the researchers to gain reasonable amount of key data which was extracted from the participants (Figure 15).

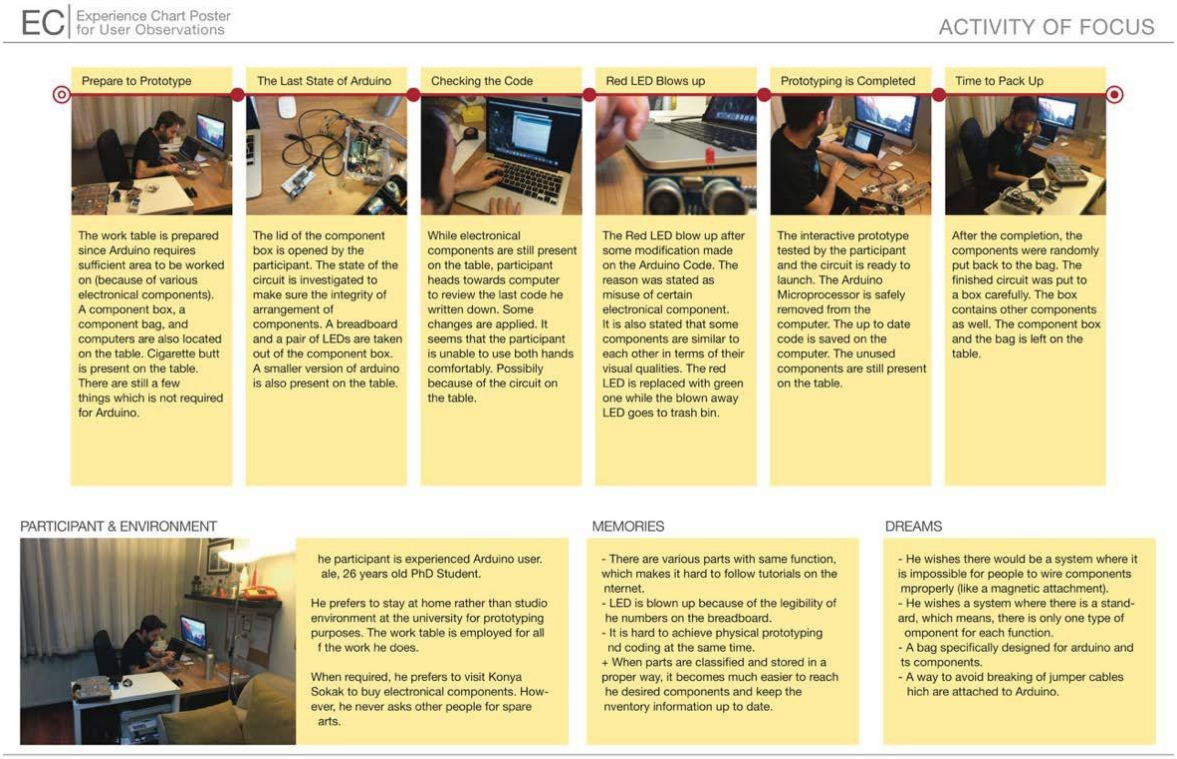

Figure 15. The EC Poster for one of the user observations.

The EC Guide as a Generative tool: The EC Guide was flexible to adapt for the research topic of inquiry. It also allowed the researcher to improve it considering the previous phase to fit the needs of prototyping activity. The adapted tool (Figure 16) was utilized in the study with four participants, all of which were third-year industrial design students. All of the stages in the

adapted tool included clear explanations of how they should be completed. *Activity timeline* stage included three different timelines grouped and presented together, which were *physical*, *phigital* and *digital*, as they represented different aspects of prototyping activity. *Phigital* is a new word which is a combination physical and digital, since particular prototyping activities can be both. Positive, neutral and negative signs were advised to be used as bullet points to understand simply how they feel about a certain phase. Furthermore, *follow up talk* stage was added to replace *memories & dreams* stage, to elaborate more on the study conducted with the help of the researcher, after the earlier phases were completed by the participants individually. The participants were encouraged to take photograph, which led the researcher to collect more data from that particular prototyping activity.

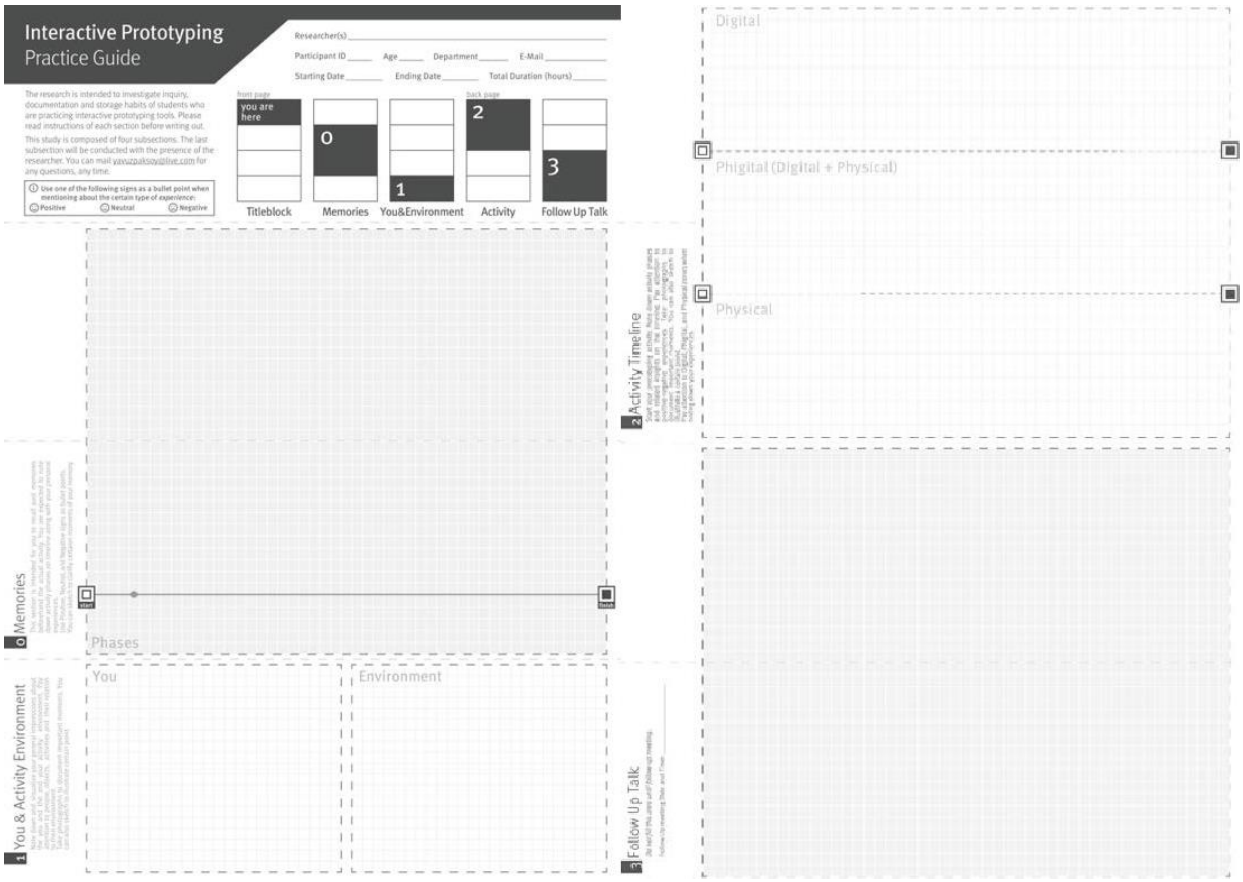

Figure 16. Adapted version of the EC Guide as a generative tool for Case 3.

In this stage, the participants had the opportunity to visualize their experiences and ideas with simple sketches, most of the points were made clearer with verbal explanation.

The ERM Method: Before starting the ERM sessions, the models of the essential standard components, storage units, tools and a laptop computer were produced for the participants so that they could transform them whichever they preferred (Figure 17).

Figure 17. The ERM toolkit for Case 3.

A voice recorder, a camera and a video recorder were used for the sessions for audio-visual recordings. Pens, tape bands, adhesives, cutting tools and many other transformation tools were utilized during the sessions for the participants to modify their models by the toolkit, to show where the problems are, and the key points of how the enhancements can be made.

Two participants were volunteered for the sessions to be carried out. One of them was a doctoral student, while the other one was an undergraduate student, both were experienced about the interactive prototyping.

The participants were reluctant to make any changes on their ERM models, since the components/parts of the ERM toolkit were designed in a very detailed way. Interestingly, the participants were willing to complete an interactive prototype for the activity, which was not the main aim (Figure 18).

One of the most useful toolkit element in the sessions was the waffle structure which helped the participants create separators, boxes, and even prototypes in a much faster fashion than a standard planar element.

Figure 18. An example from an outcome of the session: a prototype and an attachable storage unit created with the toolkit.

In the analysis part, the key insights and solutions provided by the participants were rephrased. Main research themes were generated according to the data extracted from the sessions. The presentation board (i.e. ERM Analysis Poster) was developed around three different strands of the main research considerations which were storage practices, skills and knowledge acquisition and waste/leftover materials and/or parts (Figure 19). The insights and solutions gathered from the analysis of the sessions were placed on the board and connected together when related to another insight, solution or consideration.

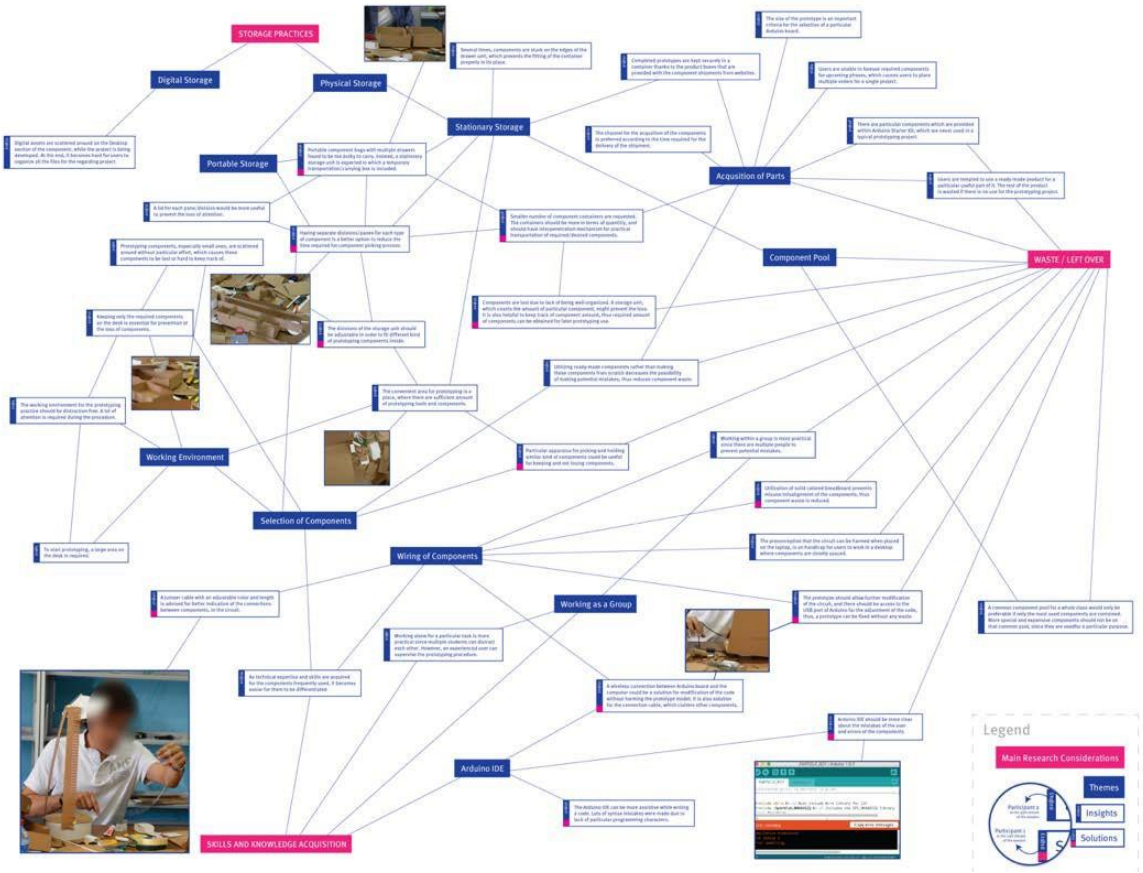

Figure 19. ERM Poster presenting the findings from the sessions.

Conclusions and Insights

The integration of the generative tool and method into the 'Generative Design Research for Sustainability' course would enable the educators to understand the potentials of the adaptation of EC Guide and ERM, and further develop the course accordingly. This experience would also encourage the graduate students to adapt diverse tools and techniques, and to develop their own methodology in their future design research projects.

Using templates for the adaptation of tool and method (i.e. EC Guide and ERM) appears to be helpful and engaging for the students. The Experience Chart part in the EC Guide mainly follows

a linear process which is effective for more specific activities (e.g. brewing tea, coffee, baking, grilling, etc.). The adaptation of EC Guide appears to be particularly difficult for the research topics to be explored in the long run – such as activities and tasks involved in design studios for the duration of a design project.

The adaptation of EC Guide led to the alternative and new stages to be included in this tool such as *model making* processes and *design solution* areas for the first case, *resource consumption* for the second, and *physical/digital prototyping* stages for the third one. Encouraging the participants to take photographs for documenting their experiences was somewhat challenging for the researchers, and alternative means of doing this could be searched – such as uploading images to blogs or online platforms while considering the confidentiality issues (e.g. restricted or private access of collected data). Areas for visualisation on the adapted EC Guides pose also challenges for the participants with no or limited skills for sketching and/or drawing. In that case, the role of researcher would be more prominent in facilitating and helping with this process.

The participants in some cases required further clarification for some of the components of the adapted EC Guides, which led to further revisions in the research phase. Within the time limitation of the course, the researchers were only able to understand and experience initial constraints of the EC Guide tool and the ERM method, which could be further explored with additional researches or pilot studies.

For the ERM adaptation, the researchers developed very detailed and thoroughly designed toolkits involving many parts which could be tailored to the participants' needs and preferences for personalization. The development of the toolkit can be considered as a lengthy process, and for educational learning goals and outcomes, this process could be planned as a teamwork, or some of the components can be co-developed and adapted through a more collaborative approach. Some toolkit parts, for instance the waffle structure, was mutually incorporated into the ERM toolkit by diverse researchers, which would show that a pool or an online platform for sharing ERM toolkit could be created for studies focusing on diverse areas. This might also decrease the number of toolkit parts remained unused. The researchers also needed help while conducting the ERM sessions in terms of audio-visual recordings. As different areas in the room were used throughout the ERM session, the angle of the cameras required to be changed accordingly. For that reason, these sessions should be planned and organized comprehensively in advance.

The adaptation and incorporation of these engaging EC Guide tool and ERM method into the course schedule led to a very intensive but productive process for the graduate students, which could potentially help them plan and facilitate their future researches through adapting a more participatory and generative approach.

References

Doğan, Ç., Turhan, S., & Bakırlıoğlu, Y. (2016). Evolving Paths: Undergraduate Design Education through Graduate and Generative Research with Particular Focus on Sustainability. *The Design Journal, 19* (4), 587-606.

Hanington, B. (2003). Methods in the Making: A perspective on the State of Human Research in Design. *Design Issues, 19*(4), pp. 9-18.

Hanington, B. (2007). Generative Research in Design Education. *International Association of Societies of Design Research Conference*, November 12-15, the Hong Kong Polytechnic University, Hong Kong, China.

Kulaksız, M. (2016). *Experience chart as a research and presentation tool for user observations supporting design students at undergraduate level* (Master's thesis). Department of Industrial Design, METU, Ankara.

Levitt, M. & Richards, S. (2010). Leveraging User Expertise through Participatory Design: Beyond Observation. *Innovation*, p. 24-27.

Martin, B. & Hanington B. (2012). *Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas, And Design Effective Solutions.* Beverly, Mass.: Rockport Publishers.

Sanders, E. B. -N. & Stappers, P. J. (2014). Probes, Toolkits and Prototypes: Three Approaches to Making in Codesigning. *CoDesign, (10)*1, 5-14.

Sanders, E. B. -N. & Stappers, P. J. (2013). *Convivial Toolbox: Generative Research for the Front End of Design*. Amsterdam: BIS Publishers.

Sanders, E. B. -N., Brandt, E., & Binder, T. (2010). A Framework for Organizing the Tools and Techniques of Participatory Design. In: Proceedings of the 11th Biennial Participatory Design Conference (PDC '10), ACM, New York, NY, USA.

Sanders, E. B. -N. (2008). An Evolving Map of Design Practice and Design Research. *Interactions, 15*(6), 13-17.

Turhan, S. (2013). *Experience Reflection Modelling (ERM) as a generative research method and student engagement in product design at undergraduate level* (Doctoral Dissertation) Department of Industrial Design, METU, Ankara.

Turhan S., Doğan Ç. (2017). Experience Reflection Modelling (ERM): A Reflective Medium Encouraging Dialogue between Users and Design Students. *CoDesign, 13* (1), 32-48.

Turhan, S. & Doğan, Ç. (2014). Experience Reflection Modelling as a Generative Research Method in an Educational Case for Sustainable Product Design. *International Journal of Sustainable Design, 2*(4), Inderscience, 297-314.

Author Biography

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He is a graduate student at the doctoral level in the Department of Industrial Design, Middle East Technical University (METU) in Ankara, Turkey and works a research assistant at the same institution. His research interests includes user observations as a part of the exploratory design research, generative design research methods, and evidence based design in design education. He holds M.Sc. and B.ID. degrees in industrial design from the Department of Industrial Design, METU. His master's thesis explored the potentials of a user observation tool for collecting user data to inspire and inform the early stages of the design process. He also works a design researcher at METU/BILTIR-UTEST Product Usability Unit since 2016.

Itır Güngör Boncukçu

In 2012 she graduated from the department of Industrial Design at Middle East Technical University (Ankara, Turkey) and in 2015 she received her master's degree. Research for masters focused on the 3D virtual worlds as new learning environments for industrial design studios. The aim of the master's thesis was firstly to explore 3D virtual worlds in terms of their current state in the world and secondly, to examine educational applications and to discuss their potentials, possible advantages and disadvantages for ID education. She now works as a research assistant and is working towards her PhD at METU, Turkey. Her research interest includes design education with focus on new learning environments, teamwork, participatory design, the use of online tools in design education, sustainability, and system/service design.

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She is graduate student at the doctoral level in the Department of Industrial Design, Middle East Technical University (METU) in Ankara where she also works as a research assistant. Her doctoral research focuses on exploring individuals' everyday practices responsible for intensive household electricity and water consumption to influence them towards sustainable directions through developing design directions with a generative approach. She holds a M.Sc. (2014) and B.ID. (2011) degrees in industrial design from the Department of Industrial Design, METU. She is also a researcher at Sustain Design Research Lab (SustainDRL) at METU since 2014. Her research interests include product design for sustainability, design for behavior change and generative research methods.

İsmail Yavuz Paksoy

He graduated from the department of Industrial Design at Izmir University of Economics (Izmir, 2012) and he received his master's degree from Middle East Technical University (Ankara, 2016). The aim of the master's thesis was to explore attitudes towards 3D surface textures for functional and hedonic product improvement. H2e now works as a research assistant in Middle East Technical University, where he is also a graduate PhD student. His research interest includes design for interaction, additive manufacturing, interactive prototyping, IoT, and industry 4.0. He is also an entrepreneur, since he is the cofounder of a company where medical utility devices are designed for diabetic patients.

Senem Turhan

She is both a design researcher and an educator. Her study areas are human-centered research (generative research, participatory approaches), design thinking and futures thinking. She pursued her post-doctoral studies at UNSW, Sydney. She previously worked as a post-doc researcher at SustainDRL and research assistant at Middle East Technical University. She got her M.Sc. and Ph.D. degrees at the same university. Her master thesis is about on the state of sustainable design education in the undergraduate industrial design programs in Turkey. Her doctoral study focuses on generative research for the idea generation phase of the product design and development process.

Çağla Doğan

As a design educator and researcher, she has knowledge and experience at undergraduate and graduate levels. She has several years of teaching experience, including industrial design studios and related theory courses, as well as graduate thesis supervision. She has a well-established research focus on design research and education for sustainability and numerous publications in this field. She also has much experience in interdisciplinary teams and learning. She holds a Ph.D. in product design for sustainability from the Faculty of Environmental Design, University of Calgary, and M.Sc. and B.ID. degrees in industrial design from the Department of Industrial Design, METU in Ankara where she has been founder and projects coordinator of the Sustain Design Research Lab. Her design-based research focuses on product design, design research and design education for sustainability, particularly integrated scales of design and production i.e. relationships among batch production, mass production, craft, do-it-yourself and open design; localization and personalization – product value, longevity and meaning; generative research for sustainability; and grounded theory and research through design.