Design Thinking to Familiarize Hearing-Impaired Architectural Drafting Students with Human-Centered Design Concept

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Abstract

Purpose
Developing a human-centered design understanding in built environment-related professions and enabling them to encompass diversity are crucial for the improvement of more inclusive environments. Considering the value of guiding experiences of people with disabilities for more inclusive design practice and increasing the awareness of professionals with disabilities in design and building practice plays a key role in achieving this goal. There is a growing effort to implement inclusive and universal design issues to the educational programs of design and related disciplines for about two decades. Contrary to the developments in the pedagogy of "core" design disciplines, human-centered design perspective seems not to be widespread enough in the education of so-called "peripheral"

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occupations of design, like architectural drafting, especially in Turkey. Design Thinking (DT) approach, which is defined as a way of thinking, is in fact widely used in the design-related fields. In such a need of human-centered and creative problem solving, the approach seems to provide a potential to raise awareness about user-oriented design in such peripheral occupations like architectural drafting education. Considering the widening use of strategies of DT also in non-design fields, the research out of which this article comes from involves a special adaption of the approach. Departing from the ultimate aim "to raise awareness of hearing-impaired architectural drafting students about user oriented architectural design," it applies the strategies of the DT to this special case and reports the process and its findings, hence not only providing a special instance of the model but also revealing its potential contribution to peripheral or non-design disciplines.

Design/Methodology/Approach

Since it particularly focuses on understanding of human behavior, provides flexible and holistic tools to investigate such phenomena and since it is based on a systematic and reflective process, the present research was carried out through qualitative research approach and its tools.

Findings

Study showed that in relation to hearing-impaired students' underlined need for getting familiarized with the process of architectural design and focusing on human-centered design approach, present application of Design Thinking strategy worked effectively to provide basic information about architectural design, design process, and related tasks and user needs as well, as part of design process for hearing-impaired architectural drafting students with a certain level of hearing loss and language ability.

Research Limitations/Implications

Since the research was embedded within the existing educational system, data collection and observation processes had to be defined according to these boundaries. Also the students' level of language abilities and their limited background about their field of study, because that they were first year students were the main limitations of the study. Apart from its aforementioned outcome, the research was a means of expanding the application of the initial DT model, and it could be seen as a contribution to the existing studies concerning the education of the hearing-impaired students. In general, the research illustrated that DT, as a carefully developed approach to be employed particularly for non-design occupations, could also be effectively used to teach design process for disabled design professionals. Consequently, it is thought that it could be applied to the formulation of courses such as; environmental design, design for all, inclusive design, as well as be utilized for students developing empathy with users, familiarizing with observation and interview techniques, and as a means of quick and systematic problem solving sessions.

Practical Implications

As it might be expected the study primarily contributes to the education of the hearing-impaired students. It helped students to develop an understanding of design process as well as develop their

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professional schemata (i.e. their conceptual vocabulary). As a research it provides a foundational knowledge concerning application of DT strategies in a specific field of study.

Social Implications

By nature, one of the basic problems confronting students with disabilities is to make them an integrated part of the society, from daily life to some specialized situations such as professional life and their education. Researcher strongly believes that this study has had implications as such although it was not primarily involved with such a goal.

Originality/Value

As it might be guessed the present study might be considered as a part of and a contribution to a larger research tradition evolving around the Design Thinking approach, i.e. its application and adaptation to different areas and field, and development of the strategy itself. On the other hand, since it adapts and applies DT to a specific case, and an original problem situation, actually a very rarely addressed one. As such, while it might be considered as a special contribution to that specific tradition, at the same time its primary contribution is to the education of the hearing-impaired students, and its pedagogy.

INTRODUCTION: THE THEORETICAL AND CONCEPTUAL FRAMEWORK

The social concerns of disability have been the central issue within the disability studies both in United States and in Great Britain, since 1970s. They both share the same goal of eliminating environmental barriers either in social or in physical spheres. It could be claimed, "everyone is disabled," to a certain extent, given the (poor) physical environment, by poorly designed products, services and by the (straining or incompatible) social environment. This is the "social model" of disability as it was differentiated from the so-called "medical model," which defines disability as a medical condition of an individual that defines a person's identity (UPIAS, 1976; Owen & Johnston, 2003; Shakespeare, 2010).

The United Nations Convention on the Rights of People with Disabilities (CRPD) is the first comprehensive treaty establishing the right of people with all types of disabilities to equality, dignity, autonomy, and full participation in society (United Nations, 2008). Based on this perspective, controlling the enabling, or disabling power of environmental factors and making design process more inclusive for everyone are underlined as the main issues of designers (Ostroff, 2010). This requires developing in-depth understanding about diverse conditions of users. In addition to improve designer's abilities and tools to search for user experience, it is emphasized that, not only active participation of users to design process as user/experts and sharing their experiences with designers, but also increasing the representation of designers with different

abilities in design professions is critical to develop more inclusive environments for everyone (Ostroff, 1997; Manley et al., 2011).

In the last few decades, studies strongly indicate the importance of developing a human-centered design understanding in disciplines and occupations concerning the built environment, in order to eliminate environmental barriers and formation of more inclusive environments for all users (ResAP, 2001); Morrow, 2002). The Committee of Ministers of the Council of Europe provided a regulation for vocational and higher education, on the introduction of inclusive design approach to the curricula of occupations working on the built environment (ResAp, 2001). Considering the importance of developing a human-centered design understanding among the built environment related occupations, improving awareness of built environment professionals with disabilities about human-centered design and encouraging them to contribute their experience and perspective to the design and building practice are crucial (Manley et al., 2011). As it is understood from the above emphasis, this transformation will begin with the education of built environment-related occupations and with the implementation of human-centered design approach to their educational programs.

In addressing abovementioned situation, Design Thinking (DT) approach seems to be a plausible model to embrace. This is because apart from its major application in design-related fields, it is becoming more recognized in non-design areas, since it offers that ability of design can be learned by anyone to solve problems in an innovative and human-centered way (Dorst, 2011; Tschimmel, 2012; Shapira et al., 2017). Among the major approaches for the application of DT, IDEO's concept of DT is underlined, which provided detailed steps of their process and cases to disseminate their methods for people in non-design fields, like management, education, health (Kimbell, 2011; Tschimmel, 2012; Johansson-Sköldberg et al., 2013). Essential aspects of DT are defined as empathy, ideation, and experimentation, which reflect a user oriented design activity. Providing a useful process that is based on emphasizing with users, DT has a great potential to extend the issue of human-centered design perspective towards the education of non-design occupations of built environment and familiarize architectural drafting students with human-centered design process.

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THE PROBLEM SITUATION

Architectural design and its major application in building sector operates through cooperation of diverse professions from architects, engineers, architectural drafters to construction workers. Although their fields of study and responsibilities are very different, a human-centered design understanding as a common framework seems to be plausible in order to support the design process properly, participate the teamwork efficiently, and establish effective communication as a team member. It is obvious that gaining awareness about inclusive design approach is necessary for peripheral occupations of design to contribute the creation of inclusive environments and the removal of barriers.

Architectural drafting is one of such occupations, whose education requires covering "architectural design culture" as one of the important issues in its curriculum, since an architectural drafter work with architects and engineers by preparing detailed drawings of architectural and structural features of buildings. This job description involves knowledge about drawing techniques, building types, building materials, and construction, as well as knowledge about architectural design process. The emphasis is not on learning architectural design but on being acquainted with design process, how architects doing design, gaining awareness about human-centered architectural design activity.

However, despite remarkable progress in the education of design disciplines towards more inclusive design approach (Welch, 1995; Preiser & Ostroff, 2001; Morrow, 2002; Manley et al., 2011), there is no adequate development in the education of peripheral occupations of design, like architectural drafting. Neither information about architectural design process nor human-centered design approach and related issues seems to be addressed among the main objectives in the curriculums of architectural drafting programs in Turkey. When it comes to disabled students in architectural drafting education, the issue is vaguer.

Embedded within the abovementioned complex framework and in addressing the aforementioned issues/concerns/goals the present study is employed as an integral part of a teaching/learning process conducted in a special educational setting. The research involves first year hearing-impaired students of Architectural Drafting Program of the School for the Handicapped, Anadolu University, between the fall and spring semester of 2017-2018. With a special emphasis on the issue of "raising awareness of hearing-impaired architectural drafting students about user oriented architectural design," the educational process provided both basic information about user

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oriented design approach and a hands-on experience concerning its practical application. The strategies of the DT approach were employed.

Conducted as a part of such an experience, the main purpose of the research is to understand and define the contribution of DT as a teaching strategy, particularly towards familiarizing hearing-impaired architectural drafting students' with "user oriented architectural design process" in relation to their occupation.[1] The research question was defined as "how the process of DT activity was performed?" The present study reports the process and its findings, hence not only providing a special instance of the model but also revealing its potential contribution to peripheral or even to non-design disciplines. Moreover, considering the information gap on these issues in both the design literature, and the literature concerning education of the handicapped, the research was also expected to contribute to these research frameworks.

THE EDUCATIONAL SETTING

The research was carried out with the participation of hearing-impaired architectural drafting students at the School for the Handicapped (Engelliler Entegre Yüksekokulu), Anadolu University. The School for the Handicapped (SFH) is an institution that provides university level education for hearing-impaired students in Turkey. Among students with disabilities, hearing-impaired students form a different group, which requires adaptation of education programs for their needs, due to their limitations of language use. The vocational education of SFH are supported with scientific researches for the improvement of the university level education of hearing-impaired students. Architectural Drafting is one of the associate degree programs of SFH, which aims to train hearing-impaired students as a technical staff for building industry. Preparing hearing-impaired students for their future workplaces and equipping them with required skills and knowledge are the main goals of the school. As part of these goals, language support is given, along with the field courses, for the improvement of communicational skills of the students in workplaces.

Since the architectural drafting occupation requires active and constant interaction with architects, civil engineers, contractors, learning effective use of professional language of building industry and architectural design is necessary for the students of architectural drafting. In the field courses, students learn most of the terms, concepts, and processes of the field of architecture and built environment. The focus of the courses is on building types, elements of building, structural elements, materials, furniture organization, drawing techniques, computer based

[1] Although there is no existing research addressing architectural design education of hearing-impaired students, a few notes from the previous experience of the researcher must suffice here. The aforementioned specialized-school once have had an "integrated" department of architecture, a four-year undergraduate program precisely reserved for hearing-impaired students working in corporation with the existing architectural department of Anadolu University. As observed from the classes and particularly from the design studios, architecture, a discipline that, to a great extent, relies on verbal communication/dialogue and being itself a language, depending much upon immaterial and abstract concepts, was a real challenge for a hearing impaired student. Suprisingly, at that time existing research on education of the hearing-impaired did not help, possibly because of the mostly ill-defined nature of architectural knowledge, and of course the design process itself. "Integration" carried the department so far, and actually it was thought to be particularly beneficial for he students to "feel" as a part of the society. But, all educators involved in this special case, including the present researcher, then suspected that such an undertaking required a setting and set of unique pedagogical considerations, perhaps even novel models, those exist neither within that great tradition of architectural education, nor within the vast mainstream hearing-impaired education doctrines. There was no chance to continue such explorations, since the program was frozen.

drawing. Although graduates are expected to work mostly as part of the process of architectural design and be in close relationship with architects, familiarizing students with the concept of "architectural design" is not among the main objectives of the curriculum, or the topics of the courses. The notion of "architectural design," is just covered in one or two-week topic in one course.

From the responses of students, and graduates, it was observed that studying on definitions and examples were not enough to understand "architectural design," since it is actually a process based and an activity that is learned by doing. It was also observed that, after two-year intense education of architectural drafting program, learning the main issues, terms, concepts and processes of architecture, some of the senior students, even graduates used the terms "architectural design" and "technical drawing," and "architect" and "architectural drafter" interchangeably showing the lack of developing a keen understanding about "architectural design."

These problems indicate that there is a need for a strategy to improve students' understanding of "architectural design," at least for accurate conceptualization of "architectural drafting" as their own occupation. It is important for hearing-impaired architectural drafting students to get familiar with "doing user-oriented architectural design," "process of architectural design," and related terms and concepts in order to perform design related tasks, establish meaningful, effective communication with their colleagues in workplaces, and transfer their experiences as professionals especially in addressing the disability problems concerning the build environment.

Design learning is a compelling process by nature, since it requires certain level of knowledge, complexity of skills, and time for improvement, particularly for participants from non-design fields. Although providing a complete design education is not the purpose here, it is also necessary to support hearing-impaired students with additional measures in an application of simplified design process that aims to raise awareness. The researcher's eight years of experience with education of hearing-impaired architecture students on design also supports this.

THE RESEARCH SETTING AND THE METHOD
The qualitative research approach focuses on understanding of human behavior, provides flexible and holistic tools to search for the phenomena and it is based on systematic and reflective process (Lincoln & Guba, 1985; Bogdan & Biklen, 2007; Glesne, 2011). Since the main purpose of the research was to explain the design learning process of hearing-impaired students and working with hearing-impaired students needs systematic and

reflective approach, qualitative research approach and its concomitant techniques and strategies were selected to focus on design learning processes of students.

Typically, there are three types of data gathering methods most commonly used in qualitative research; interview, observation and document analysis. In the present study, to increase the quality of the research by confirming the credibility of the data collected in the study and provide a broader perspective various data collection techniques were used together.[2] On this base, observation and document analysis were selected as the main data collection techniques of the research. Written documents involved student and instructor diaries, the reports of planning and evaluation meetings of trustworthiness committee, course plans, and messages of Facebook course group, e-mails, student presentations. Additionaly course products, which were developed for course assessment during the course and process photographs, were used to support main data gathering techniques. All data obtained, as observation notes and written documents, were analyzed descriptively during and after the process. Analysis of the research data was made simultaneously in a cyclical, systematic, and reflective way. As it was underlined by Lincoln and Guba (1985) trustworthiness in qualitative researches, as compared to validity and reliability criteria is of prime importance. The main criteria of trustworthiness are expressed as credibility, dependability, confirmability, and transferability. With this purpose, opinions and suggestions of the field expert were taken throughout the planning and evaluation meetings in the research.

The research was conducted at the Department of Architecture and City Planning, Architectural Drafting associate degree program, SFH, Anadolu University. The research data was collected from the twelve weeks of the Professional Language I-II courses of the program. For the research, one classroom was used. Considering hearing requirements of the students, the classroom, where the research was conducted, was equipped with appropriate sound insulation (Girgin, 2003). To support educational setting in the classroom, there were equipment like a smart board, eleven tables (four of them was used), which were also compatible with technical drawing studies, eleven chairs (five of them was used), a small additional mobile board, and wall panels to mount class works of the students (Figure 1).
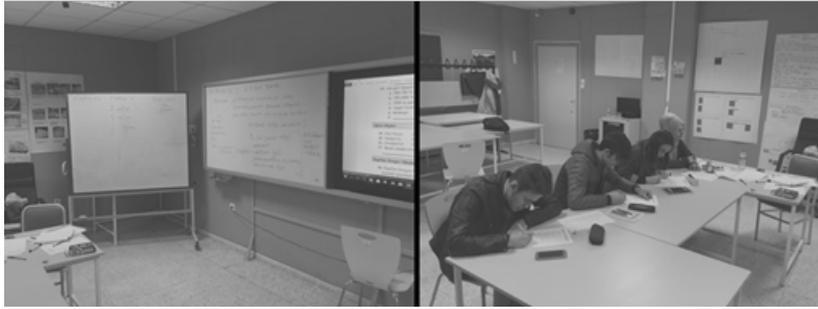
[2] Observation is a widely used method in qualitative research in order to describe the behavior that occurs in any environment in detail. Observing human behavior in its natural environment is a prerequisite for a realistic examination of these behaviors. It is also underlined that document analysis, as one of the main data gathering techniques, can be used as a primary data collection technique, or it can be used as a supportive tool, when other data collection techniques are used in qualitative researches. Curriculum documents, student records, meeting reports, student works and exams, teacher files, class diaries can be used as main data sources in qualitative educational researches (Bogdan & Biklen, 2007; Şimşek & Yıldırım, 2011). When document analysis is used with other data collection methods such as observation and interview, it increases the validity of the research to serve the purpose of data triangulation (Şimşek & Yıldırım, 2011).

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Students, an instructor (researcher), and a field expert were the main participants of the research. There were five student participants. They were first year students of Architectural Drafting program in the fall and spring terms of 2017-2018 school year. They had severe and profound level of hearing-impairment (Table 1). The students wore ear level hearing aids. The average age of the students was 19. All of the students were informed about the purpose, process, and dissemination of the research and all of them participated voluntarily (Ryen, 2011).

Table 1. General characteristics of participant students

	Student	Age	Gender	Hearing Loss (dBHL)	
				Right	Left
1	NA	20	FM	75	57
2	HA	20	M	97	103
3	Nİ	18	FM	97	100
4	SA	18	M	87	87
5	İS	18	M	110	110

The researcher and the consultant were academicians. The researcher as the instructor of the course had expertise of 23 years in higher education of hearing-impaired students covering Program of Architecture and Program of Architectural Drafting. In addition, she had a PhD degree in architecture and education of architectural design. She conducted architectural design studio courses in other architecture departments with normal hearing students for about 20 years. She conducted and participated academic researches on architectural design, user participation, and education of hearing-impaired, and qualitative action-research.

The consultant as a field expert of education of hearing-impaired students had 24 years of experience. Trustworthiness of data collection were carried out by the researcher and the consultant. As an academic member of the administration board of the SFH, the consultant both coordinated action-research projects and contributed them as a researcher. She had a Ph. D. degree in the education of hearing-impaired. Both researcher and the consultant had academic publications on education of hearing-impaired at university level.

The research data was collected with the DT activity phase of the research, during the last nine weeks of fall semester and first three weeks of spring semester of the 2017-2018 educational year. Data collection and analysis were organized with the contribution of planning and evaluation meetings. The research was conducted with a weekly systematic process in relation to planning and evaluation meetings (Figure 2).
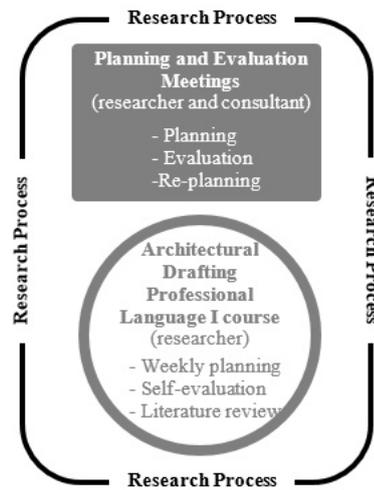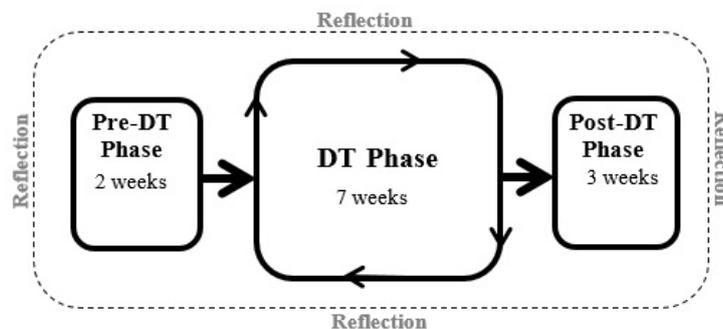

Figure 2. The research cycle

The planning and evaluation meetings were held nearly in every three weeks from the beginning of the process. There were five planning and evaluation meetings during the research process. Information was shared through office meetings, e-mails, and reports with the researcher and the consultant. Before and after each sub-phase of the research, the course plans and produced material were examined in the meetings.

THE STUDY, FINDINGS, AND EVALUATION
The findings of the study are presented in relation to the research question "how the process of DT activity was performed?" The DT activity process of hearing-impaired architectural drafting students consisted of three main phases; Pre-DT phase, DT phase, and Post-DT phase (Figure 3).

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Although the main DT activity was conducted in the concerned phase, pre and post phases were planned considering the learning needs of hearing-impaired university students, (Uzuner et al., 2011; Kaya et al., 2013; Uzuner and Derican, 2013; İstel, 2018). Pre-DT phase aimed to prepare the students to participate design process, providing them base information and a reason "why they need to familiarize with architectural design." On the other hand, Post-Dt phase aimed to provide students an opportunity to think on their previous design processes with a different assignment involving a different design problem. These phases of the process were explained in in the following part.

Pre-DT Phase
Pre-DT was a two-week phase and aimed to provide students main concepts of their field Architectural Drafting, which included clarification and consolidation of the concepts; architecture, architect, architectural design, architectural drafting, drafter, technical drawing (Figure 4). Although this phase was not directly related with the DT activity and design process of students, it provided students a base for the next DT phase. The main objectives of this preliminary phase were:

1. Providing students a knowledge base, a framework about their profession; architectural drafting, about their drawing related duties and responsibilities in workplaces, about its relation with architecture, architectural design.
2. Informing them specifically about design, architectural design, and examples of design to raise an interest about design process, which was the main issue of next phase.

Figure 4. Examples from the student presentations and class notes in pre-DT phase (Photograph by the author, 2017)

Design Thinking (DT) Phase
DT phase of the research was about eight-week phase. This was the main process of DT activity of architectural drafting students. The main goal of the DT phase was to enable students to execute a simple design process through their own learning by doing actions.
Before presentation of the findings of this phase, general overview of the adaptation of DT4E, as one of the DT approaches, is provided. DT4E is developed by IDEO group for the educators

specifically (IDEO, 2012). DT4E originally suggested five main steps of design; discovery, interpretation, ideation, experimentation, and evolution (Figure 5).

Figure 5. Main steps of DT4E (IDEO, 2012)

It is explained in the DT4E model of DT process that discovery step covers understanding the challenge, preparation of research, and gathering inspiration. Interpretation step includes telling stories, searching for meaning, and framing opportunities; ideation step includes generating ideas and refining them; experimentation step covers making prototypes and getting feedback activities; evolution step covers tracking learnings and moving forward (IDEO, 2012). Although these are the suggested steps of DT process in action, it is noted by the developers that this steps can be adapted by educators according to their aim, problem, and setting, without losing its core relations and meaning. Since present research aimed to provide architectural drafting students an acquaintance with the process of architectural design, there was a time limit for applying the process, and there was not a considerable framework for teaching design to hearing-impaired students, except a master thesis, which was conducted with graphic arts students in SFH (Uzuner and Derican, 2013). In his study, the discussion was not specifically on teaching design process to hearing-impaired Graphic Arts students. It was an action research process, which applied on design teaching-learning process and exemplified students' designing processes of portfolio, so portfolio design process itself may provide important clues of designing experiences of students and action research process, which has similarities with design process for the research.

The DT activity process of hearing-impaired Architectural Drafting must response also learning needs of hearing-impaired students and involve teaching-strategies for hearing-impaired students. It is underlined the importance of meaningful and active settings to apply learned skills and knowledge, importance of real goal and/or product oriented education, importance of how the process is taken place (Uzuner et al., 2011; Kaya et al., 2013). Kaya et al. (2013) stated that doing exercises in order to teach required skills is more successful if it is done after theoretical knowledge was given to hearing-impaired students as a successive activity. Kaya also underlined the importance of

repetitions and enrichments for the improvement of required skills and knowledge. Assessment process is also critical for the education of hearing impaired. The techniques like question-answer sessions during the class, successive activity, and enrichment activity at the end of the class, control lists, which help students to evaluate their learning processes, application procedures, pre and posttests, and monitoring assessments during the class provide support for assessment of the learning-teaching process for both teachers and students (Kaya et al., 2013). The findings of Uzuner and Derican (2013) also support the validity of these techniques in graphic design teaching. In the DT process, design-learning process of hearing-impaired Architectural Drafting students was carried out with combining underlined techniques.

With these grounds, DT phase of hearing-impaired students was organized with four main activities, which corresponded to identified five steps of DT4E (IDEO, 2012), which were problem framing, idea generation, testing and evolution. Table 2 shows the duration of these steps.

In the present research, both discovery and interpretation steps of the DT4E model were combined in one step as problem framing, since performing discovery and interpretation steps together. This provided students data collection and reflection on collected information about what was found and what was required in sub-activities, which was more beneficial and meaningful considering learning needs of hearing-impaired students.

Table 2. The duration of the main steps of DT phase

The name of the step	Date	Duration	
Problem Framing	October 30, 2017 – November 13, 2017	3 weeks	
Idea Generation	November 20, 2017 – December 04, 2017	2 weeks	3 weeks
Testing	December 18, 2017	1 week	
Evolution	December 25, 2017	1 week	

Although the main steps of the DT phase showed a successive character, the steps were also iterative and reflective. Idea generation and testing steps of the DT phase corresponded ideation and experimentation steps of DT4E. Considering suggested teaching strategies for hearing-impaired and clarity of design process for students, who were unfamiliar with design process, it was also decided that integrating idea generation and testing steps together was more efficient and persistent. This is since the process involved regeneration and refinement activities successively, which required students testing the idea with the data coming from their research in each cycle (Planning

and Evaluation Meeting, 2017). Evolution step was remained the same with DT4E, however, its reflective and implementation oriented activities were limited with thinking on "what was done and learned in the design process?" and sharing the process with others, since the time limit of the course. The steps of DT phase involved various sub-activities; Figure 6 shows main steps of DT phase and these sub-activities.
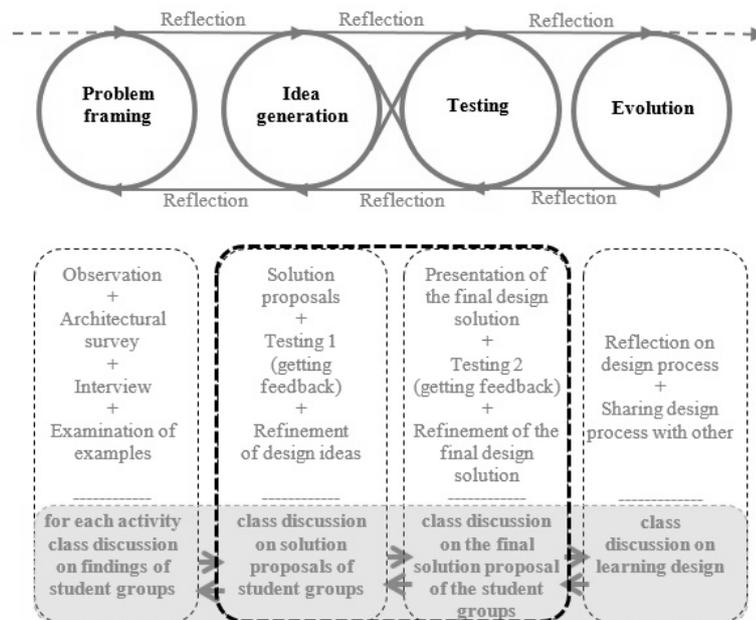

Figure 6. Main steps of design thinking (DT) phase and sub-activities

In addition to class hours (three hours a week), additional hours were used as a support for students in some weeks and Facebook course group was used for discussion, question-answer, and archive of the material produced in activities, and planning during the process. At the beginning of the DT phase, students were informed about the overall activities and the process. They were asked to make two separate groups. The design problem was selected from architectural design field. However, considering designing a space from the scratch was a highly complex problem for those who did not familiar with design, it was decided to be a space organization problem. At the end, the instructor suggested that two of the school spaces that could be redesigned by the students. They participated to the idea. Each group decided on their problem spaces; entrance hall was selected by the group 1 and canteen was selected by the group 2.

In the problem-framing step, students were expected to search their design problem with various research tools and define the situation, problems, needs, and user opinions in relation to design problem. With this goal, the main tasks of the students were:

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1. Observing the space; defining usage, furniture, users, relations, times of use

2. Architectural surveying; documenting the space and existing furniture with sketching, measuring

3. Interviewing; preparing questions for defined users and conducting the interview

4. Examining and observing example spaces

5. Preparing power point presentations for each task with written notes, photographs, and drawings

During all these tasks, students were asked to write their experiences including problems of the spaces and needs of the users, which they noticed while their observations. These tasks of problem framing step were conducted in three weeks; the purpose of the first week was to constitute a general picture about the selected spaces from the perspectives of the students. Observation and documentation of the spaces were the main tasks in this week. Before the assignment, students were informed about the aim of the step, observation technique, and architectural survey.

The purpose of the second and third weeks was to develop awareness of students about the users of their spaces and user opinions, diversify their experiences about the spaces with similar functions, and based on their previous week's information and perspective, improve their understanding about the problems and needs about their spaces, with the contribution of new research perspective. After the observation task, the students asked to choose exemplary spaces from the university campus with similar functions of their spaces. Through this, they diversified their experiences and knowledge about the usage, users, and furniture organization about canteen and entrance hall spaces in order to develop a design idea for their spaces in SFH (Figure 7). At the end of this three-week problem-framing step, to solve their design problem, the students gained a rich information base:

1. They familiarized with the user, who were different from themselves.

2. They familiarized with various research tools to understand their design problem.

3. They analyzed and discussed their findings in each team and in class.

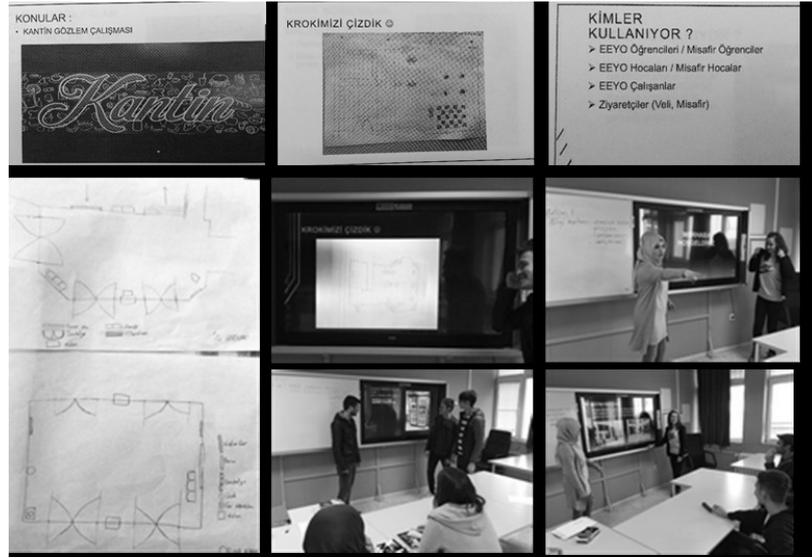4. They used architectural drafting techniques for their design task.

Figure 7. Student presentations and works of problem framing step of DT phase (Photograph by the author, 2017)

It was observed that, with this step they conceived the boundaries of their design problem and began to think on design solutions for their problems. Before the next step, students asked to write up-to-date list of problems, needs, opinions about their spaces and try developing very first design ideas for the next week. They stated that they did not know how a design proposal was prepared. They informed about sketching technique and thinking through draft drawings, testing their solutions by with their needs, opinions problems list. Idea generation and testing steps of DT phase were conducted as an integrated step. These steps took about three weeks. It had three cycles of idea generation and testing. For the first week, only one group provided their design proposal. Their proposal composed of plan and interior elevation sketches, selected furniture photographs, and written explanations for the proposal.

The first solution proposal of the group was discussed with other groups. The solution proposal testing was performed by answering the questions "did the solution meet defined needs? Which problems did it solve?" Based on the suggestions, the group was asked to revise its proposal. Next week, two groups had their proposals. The evaluation of them were made in the same way (Figure 8).
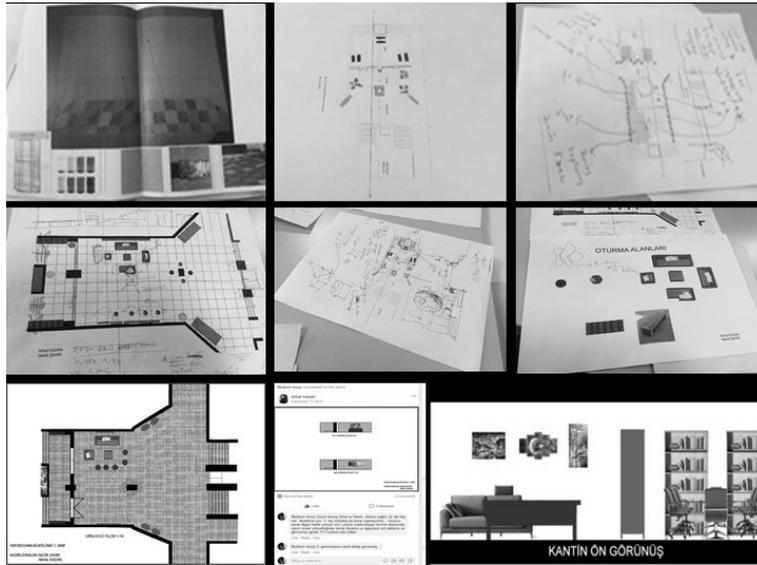
After the second cycle of proposal-testing, design solutions were
refined and the groups began to prepare their presentations for
the user evaluations of the canteen and entrance hall spaces. For
this study, they first prepared few questions about their design
proposals and they expected users to give their suggestions and
opinions. This sharing part of the study was excited student.
They mounted their design materials to the boards in canteen
and entrance hall spaces. They prepared a suggestion box and
question sheets for the users, waited with their presentation and
explained their designs to the users (Figure 9).

After they got feedback from active users of the canteen and
entrance hall spaces, gathered information was evaluated
together at the class. It was observed from the opinion sheets,
most of the users responded to the design proposals with
enthusiasm. Students said that the users, whom they explain
their design study, underlined that there was a need to revise
these spaces and the design efforts of the participant students
were necessary. The students said that some of the student users
just expressed their appreciation, not opinions about the design
study. On the other hand, some of them discussed the design

decisions, provided opinions for the development of the design proposal. This was very constructive test cycle for the students, since they received various user opinions for their designs.

Evolution step of the study was used as final assessment for the DT process and the process took about one week. On previous experience, after the recall of the steps in the class, the students were asked to think on the overall design process, how they achieved it, and what they have learnt, and write their experiences. SFH had a school newspaper, which was run by the students themselves, in each semester end, the news from the students were gathered, the new design for the newspaper was created by the students. It was decided with the students that their final written process of DT delivered to semester's newspaper and the newspaper helped to disseminate their designing experience and proposals to the whole school (Figure 10).
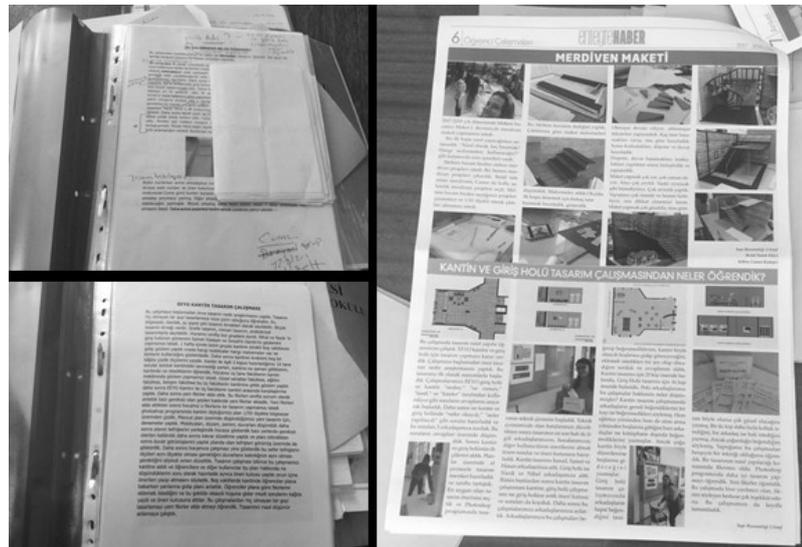
Figure 10. School newspaper article of the students from the evolution step of the DT activity (Photograph by the author, 2017-2018)

Post-DT Phase

Post-DT was a three-week phase. It aimed to reinforce the design understandings of the students with different problem context. For consolidation of students' previous experiences of design process, organization of a post-design experience phase was decided with the field expert in planning and evaluation meeting (Planning and Evaluation Meeting, January 10, 2018). This phase considered both as passing through the previous design process of students and as a new design problem solving activity for the students.

Poster preparation activity was one of the main goals of this semester. The purpose of poster presentation was to prepare and familiarize students for architectural project presentation task and reuse their information on Photoshop, gained in related

course. The theme of the poster was given to the students as their design process, which was experienced in pervious semester. The design problem was defined as a poster design for year-end exhibition of the school. The same students were grouped together.

The Post-DT phase began with recalling the concerned design process, and categorizing the steps in order. It was a bit difficult for the students first, they remembered the tasks like; observation, interview, sketching, preparing design proposal, but not with their purposes and orders. The vagueness about designing experience was considered as normal for them, because of the semester break. Their writings for the school newspaper were used for recalling the issues. Based on that, they prepared a list of steps of their design process, and then they filled each list article in two separate groups. After this content development step, the process of designing the poster began, where the tools and end-product was different from the previous one (Figure 11).

Figure 11. Student works from the post-DT phase of the design thinking activity (Photograph by the author, 2018)

Throughout the whole process, with each activity in the phases, students were encouraged to reflect on "what they were doing" and they were encouraged to follow their learning processes and ensured that they did not miss the aim of the activity. For this, the students were asked to write their experiences and opinions to their diaries after each activity, in addition to class discussions. These diaries were examined by the researcher after each activity and feedback was given to the students. Diary writing task was used not only for helping students to reveal their experiences and opinions, but also for encouraging hearing-impaired students to develop their written communication (Figure 12). In addition, the progression process of student groups was visualized continuously with the dated photographs of the class material and shared with the students shortly after each activity on the Facebook group throughout the process. This reflection phase covered whole DT activity process. The purpose of planning the Post-DT phase was to encourage students to put whole their designing activity together and reflect on this

experience. The students shared their design process with a poster presentation to the whole school at the end of the year.
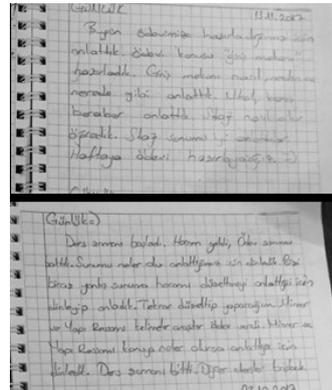

Figure 12. Examples of student diaries (Photograph by the author, 2017-2018)

DISCUSSION AND CONCLUSION

Towards the formation of more inclusive architectural environments, present research was aimed to contribute to the overlapping area between the need for training of peripheral occupations of design in user-oriented design and it addressed the need for the contribution of disabled design professionals to the profession with their experience on environmental barriers. With this aim, the study has focused on the application of DT as a teaching strategy to develop an awareness about human centered design process for hearing-impaired architectural drafting students. Hereby in the conclusion part, not only conclusive remarks and achieved goals, but also shortcomings, and possible contributions to the field, as well as a number of suggestions are provided.

Perhaps first thing to underline would be the limitations of the research: as any other research, the present research has had its limitations, one of them being its scope considering the case observed was a quite unique and refined one. From another perspective this situation could be found beneficial since it permitted the researcher a more hands-on control on the data and a more comprehensive analysis that is not only demanded by the case itself but also by the methodology. As it was stated the study was conducted as a part of a regular educational semester, and as a part of an existing curriculum. This points to further limitations such as projected time limit on observation and data collection, and since the main focus in a class setting should be the education itself, the research had to be embedded within the existing setting. The researcher strongly believes that expansion of the research both in timely manner (i.e. making it two semesters) and scopewise (i.e. including other level students) might add much to the initial findings presented here.

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In relation to hearing-impaired students' underlined need for getting familiarized with the process of architectural design and focusing on human-centered design approach, it was observed in the research that hearing-impaired architectural-drafting students gained an awareness about and develop an information base concerning the issues such as architectural design, (architectural) design process, and the essentials of the process. However, there were some deficiencies observed about their perception of design process as a whole. As for the "user oriented" emphasis of design process, it was revealed that although students developed a partial understanding for the place of "user" in design, user needs, designing in relation to the needs of user, their conception remained fragmented and limited with the design problem they solved.

Within the scope of the research, considering language limitations of the students, their lack of familiarity with the subject, and considering that it requires more time and additional learning to develop such an awareness, advanced development was not expected in students' conception of user inclusive design. However, it was thought that the students could add their experiences to their design processes, as hearing-impaired users, but they were unable to differentiate, express, and convey their experiences, although they distinguished some user groups and their specific needs in their processes.

It was observed that while the students carried out the design activity, they utilized "technical drawing" skills as part of design process, but differentiating it from design itself. Therefore, they clarified the relation of architectural drafting with architecture as a profession, and they were better positioning themselves and their professional field in relation to architecture and architects.

Therefore, it can be said that present application of DT strategy worked effectively to provide basic information about architectural design, design process, and related tasks and user needs as well, as part of design process for hearing-impaired architectural drafting students with a certain level of hearing loss and language ability.

In this case, where the students had moderate and high level of hearing loss, despite the measures such as; organization of pre and post phases, guidance of the field expert about the education of hearing-impaired, additional writing assignments on students' design processes, were taken before the process, the multi-faceted design process seemed to be challenging for the students. It was relatively hard for them to overcome and internalize new terms and tasks of the process and transfer information between phases. Additional language course support could be arranged, in order to reinforce new terms and concepts of the design process in other contexts.

Since the hearing-impaired students were junior level, they lack prior experience concerning the university level education and architectural design education. Results that are more effective could be obtained if DT strategy were carried out with senior level hearing-impaired students, since they would have developed a background about design due to their formal education and they have been completed their compulsory internships in architectural offices and gained experience at professional level. Considering that, design learning needs recurring problem solving activities, single design problem solving process may not be enough to understand design process as a whole. The process can be arranged to include more and more manageable design problems. In addition, the fact that design related issues was not mentioned in other courses may be one of the factors that make it difficult to reinforce learning.

It can be more efficient to implement the DT process by supporting it with a theoretical background, providing essentials of user inclusive design. With this respect, a specific course addressing the issues such as transferring user experience, particularly their own experiences, as hearing-impaired users to design and practice, can be formulated for hearing-impaired students.

The research showed that teaching DT activity familiarized hearing-impaired architectural drafting students with various skills and provided crucial knowledge base, which supported their education and future work life (Figure 13).

While the students are acquainted with the basic skills of design activity; problem definition, solution generation, testing, and evaluation, at the same time, they gained problem-solving experience by following defined steps of design process and reflecting on these activities. It was observed that DT activity not only helped to familiarize students with design-based skills, but also involved and supported the strategies, which were emphasized by the literature for university level education of hearing-impaired students and basic concepts and techniques of architectural drafting education as well. This was particularly important owing to the literature on vocational education of hearing-impaired students strongly emphasized the importance of providing students educational settings, involving functional and product oriented tasks and their realization processes with real goals, meta-cognitive learning, for the improvement of language skills and effective learning occurred (Uzuner et al., 2011; Kaya et al., 2013).
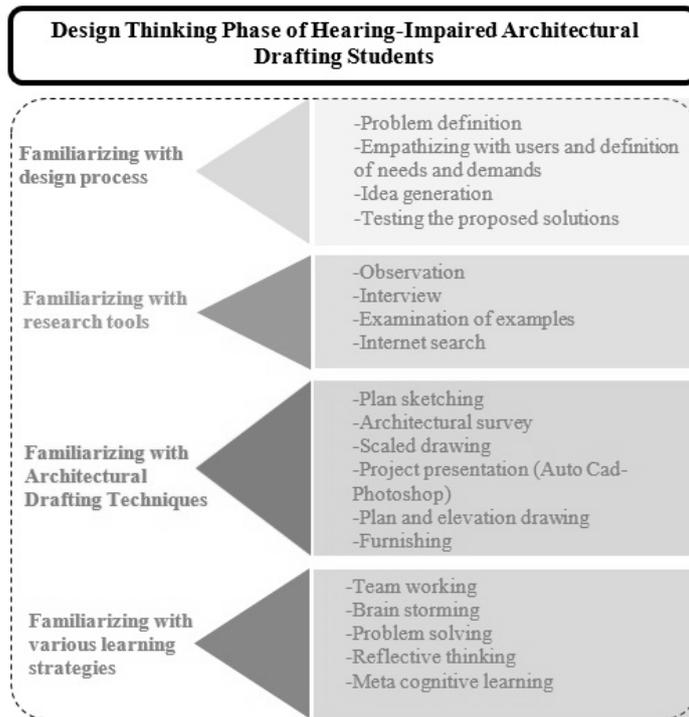
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Figure 13. The DT phase and learning dimensions

It was observed from the application of DT activity that the selection of design problem in relation to spaces of the school was particularly beneficial. These spaces, which were part of daily experiences of students; provided means of communicating with other students about real problems and needs of them; getting evaluative comments about design proposals for them seemed to provide a meaningful, functional, and purposeful educational context for hearing-impaired students. The whole iterative, cyclical, and reflective process of the students' designing activity, augmented with class discussions and diary writings on what they doing, what they are learning, and with post-DT phase, allowed the students to assess their learning and not to miss the main purpose of the designing activity as meta-cognitive learning.

The main purpose of the Professional Language course was to facilitate the understanding of the main concepts of architectural drafting and to reinforce professional language use of students with the contribution of meaningful contexts. Considering this objective, the DT activity provided students a real and meaningful design context for the use of their profession's language and allowed new terms to discuss and repeat as part of this context. During the problem-framing step, they made plan sketches, architectural survey, scaled drawings, furniture organization, and developed an idea about the differences from each other and their places of use, which were the main topics of other courses and needed to pass through in Professional Language course. Through the DT phase, they used industrial-

standard computer programs, such as Photoshop, and AutoCAD, which they studied in other courses, for their design idea presentations.

Besides familiarizing with design related skills and required knowledge and exercising on field related techniques and concepts, the students gained experience with research techniques, while trying to define their design problem and users; they conducted basic observation and interview techniques and prepared reports of their applications. An unexpected contribution of the DT activity to the students was that observation, interview, getting user feedback tasks, which required establishing communication with others, seemed to facilitate and strengthen their relations with other program students of the school and make it easy to get used to the school as the first year students.

In general, the research illustrated that DT, as a carefully developed approach to be employed particularly for non-design occupations, could also be effectively used to teach design process for disabled design professionals. Consequently, it is thought that it could be applied to the formulation of courses such as; environmental design, design for all, inclusive design, as well as be utilized for students developing empathy with users, familiarizing with observation and interview techniques, and as a means of quick and systematic problem solving sessions.

This research was about the application of DT approach to hearing-impaired architectural drafting students, combined with the existing educational framework for hearing-impaired students provides. As such, it was a means of expanding the application of the initial DT model, and contributing to the existing studies concerning the education of the hearing-impaired students. It showed that DT, with the precise adoption has a potential to evolve as a teaching strategy, which effectively integrates separate educational objectives together as part of design problem solving for the education of hearing-impaired students. Therefore, it is expected that the research can be used as a model for different educational settings, in which hearing-impaired students will be educated and it can provide a viewpoint and guiding principles for educators.

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Resume

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