Universal Design of Instruction: Definition, Principles, and Examples

Şenay BODUROĞLU

Abstract

In the society of our present time where globalization and information technologies rapidly develops, priorities must be given in every area starting from the area of design, they must be given to the persons who produce information but not to information itself; to the persons who create technology but not technology itself and to the persons who use both of them together. Depending on the technological alterations making progress consistently, having the humans start to live for longer period of time and more independently, propounded the necessity to handle traditional design understanding again and at the same time, this has made out the requirement of a new design approach which provides more availability for the products and environments universally. This design approach is

Şenay BODUROĞLU, Assist. Prof., Mimar Sinan Fine Arts University, Department of Interior Design, Fındıklı, İstanbul
E-mail: senay@msu.edu.tr

the design understanding of the future which provides participations of all user groups with the same possibilities and without limiting with special solutions or measures to different areas of life such as sheltering, education, working and entertainment by also covering handicapped users. Doing discrimination in the topic of service presented to human and preventing equal sharing of the possibilities do not comply with the design understanding of our age.

Traditionally, designer have the tendency of doing design with the concept of ''average human''. Likewise, also existing design principles have been generally formed in average ergonomic dimensions and by taking women or men users in having average capacities as the basis. But, there is something clear and it is the fact that every human shows differences from the average more or less. Humans do not have the same characteristics in terms of their movement capacities, seeing, hearing abilities and ergonomic sizes. Their strengths in the arms, physical endurances and intellectualities are different from each other. There are also some users having limited movement capabilities because of elderliness, illnesses and temporary disabilities. On the other hand, since some humans have lost their movement abilities completely from birth or afterwards, they have to use wheelchairs. In conclusion, all users show different capacity characteristics in terms of their physical abilities. For this reason, instead of doing different designs for different needs of the persons, there is the requirement to design products which can be used by everybody. By being connected to these developments in recent years, importance of having the possibility of using the structures and environments under equal terms by all user groups having different dimensions and abilities was started to be realized and there has been a continuous progress faced in the direction of having the possibility to be used by everybody. This development is mostly seen in public buildings and houses which are required to have suitable living standard. Particularly, accessibility concept participated to the first stage of designed products. First of all, together with the unhindered design movement in 1950s, changeover has taken started in public policies and design applications. The fact for the occurrence of problem was accepted for the physical obstacles taking place in the environment regarding the persons who have difficulty in moving and improvement of national standards was provided for the buildings that do not have obstacles. In1970s, while environmental obstacles were getting eliminated, a new concept was put forward which would increase everybody's functional capacity by having broader and more universal characteristic

than accessibility. This new concept is the concept of "Universal Design".

Universal design is the thought for everybody to have accessibility to every object and everywhere at all times. It is the environment, building and product design which embraces, shelters everybody with its generous soul by giving importance to details. Universal Design, is the design understanding which provides independence to users as much as possible, complying with the special requirements of the users, superior in aesthetics, providing information to user and at the same time, it is sustainable design understanding. While universal designers do designs for various user groups, they integrate rudiments accustomed during their works with the characteristic of usability by everybody. This approach style provides guidance to design method to include in the design so many user groups more who were often neglected before (kids, elders, short persons, weak people, etc.). Many universal concepts contained in Universal Design approach form the designs which are thought with a unique way to enable the persons who have physical restrictions life more independently. It is the design understanding to meet all needs of the users equally. For this reason, understanding the concept correctly has big importance in terms of its application and expansion. Universal design concept shall be narrated in the scope of the study and design principles and guides belonging to these guides shall be explained with examples.

INTRODUCTION

Built-up environment show a chain structuring from indoors of the building to urban external sites and even to parts of the nature surrounding the city. Together with the years of 1980s, some designers and their limited number of supporters started to apprehend the importance of designing more useable products and environments for everybody regardless of the age and capability. By the courtesy of this, continuing developments were achieved in the buildings and outdoors during the recent years in the name of functionality. This depends on all kinds of sites taking place within the building to be able to fulfill their functions together with being accessible, useable and habitable alongside of being designed in the orientation of their users. Usability becomes obtained by everybody in a physical environment not having obstacles and by being designed suitably. Sites that can be used by everybody are accessible-reachable, unobstructed sites.

Since the number of persons who had to live with their temporary or permanent handicaps specially occurred after

World War II in the result of heavy physical and psychic traumas has increased in a considerable amount, their existences has started to gain importance and many international institutions and States have started works in this direction so that they could gain place in the society and sustain their social and work lives. In developed countries, concepts such as Accessible-Unobstructed design, adaptable design and universal design have developed respectively. From these concepts, it is important to discriminate universal design used in obtaining products and accessibility in the environment.

UNIVERSAL DESIGN CONCEPT

Unobstructed-Accessible design means having the possibility of using and reaching the products and buildings by handicapped persons. Adaptable design is the design of the products and environments which can have the characteristics to be adapted conveniently for the needs of special users. Distinguished characteristic of adaptable design solutions is having the compulsion of adoption and addition to existing product and environment in order to make the product and environment more useable. On the other hand, Universal Design means usability and accessibility of the products and buildings by everybody including handicapped persons as well. Unobstructed-Accessible design has tendency of providing separate conveniences for handicapped persons, for example, starting of the ramp in the entrance on the side of the stairs or toilet cabins which can be reached with wheelchair can be shown as the sample of unobstructed-accessible design. On the other hand, Universal Design provides solutions addressing both handicapped persons and also remaining part of the population. Other than this, universal design has the meaning to respond to the needs of the persons who are older also young ones, both women and men, persons who their right hands and also the persons who use their left hands. When entrance is designed universally, it must not have entire stairs. Instead of designing only one toilet cabin for the persons who use wheelchairs, universally designed toilet site must cover cabins with more space and possibly the places allocated for special service, for example, replacing the diaper to babies.

During recent years, interest for universal design is getting increased interest during recent years as the alternative to accessible design. Reasons of this can be listed as below (Steinfeld, 1994):

• Increase in the number of people who have to live together with their disabilities,
• Extension in the length of life,
• Purchasing power increase of handicapped population,

• Becoming aware about inadequacies of auxiliary technologies,
• Designs of products and environments in a way not being able to respond the expectations of the old.

Throughout twentieth century, changes in population, law and economy, social changes between the old persons and handicapped people, have formed the beginning point of universal design which comes in sight like a sprouting seed and takes deep and powerful root afterwards. In the United States of America, this design approach named as "Ecumenist-Universal", and named as "Encapsulating-Inclusive" in European countries has the purpose of making the ways of usage for the products and environments by the people who are handicapped or not and have different sizes and capabilities, kids and old persons. The definition and principles of the universal design is developed by a group in America, North Carolina University, called as "The Center for Universal Design". The Center for Universal Design has defined the concept and its objectives as follows:

"Universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (Wolfang and Ostroff, 2001).

"The intent of universal design is to simplify life for everyone by making products, communications, and the built environment more usable by as many people as possible at little or no extra cost. Universal design benefits people of all ages and abilities" (Wolfang and Ostroff, 2001).

The universal design will be favourable to the extent it is generalised. Any developed new idea requires principles established for practical purposes and assisting the fast extension of the main idea. The purpose of the universal design principles and related guides is to define the concept in a substantial manner.

UNIVERSAL DESIGN PRINCIPLES
The universal design principles are the main principles applied in all design disciplines that cover the surrounding environment, products and communication. Principles provide guidance for design methods, they participate in the production of design solutions by providing the evaluation of the design systematically. "The Center of Universal Design" is a work group where representatives from different vocation groups such as architecture, industrial design, engineer and environmental designing. This group has met in December of 1995 with the purpose of determining universal design principles and it has

published seven principles of universal design (Wolfang and Ostroff, 2001). These principles are the ones used in order to make the assessment of existing designs for all user groups and for the trainings of designers and customers about more usable products and environments.

1. EQUITABLE USE

The equal use means the design to be usable and purchasable by persons with different skills and capacities. In addition, it also means providing equal services for all the users without any discrimination, protection of confidentially and thinking the design in an attractive form. Design must be used by the persons who have very different abilities. This principle is valid both for product design and also for the design of the place. Guidelines of principles (Wolfang and Ostroff, 2001):

1. For all users, the value of usage must have the same value. If possible, there must be the same usage at all times and equivalent usage when it is not possible.
2. For all users, it must avoid discrimination.

Figure 1. Examples of Guideline 1 and Guideline 2 (*Lavine, 2003, http://www.theflyingcashew.com/2012/07/02/accessibility-a-design-principle/*).

Figure 1.

Having the placements on different heights for the telephones taking place in the public area seen in the first example as seen in the first sample taking place in Figure 1 provide equal usage possibility for the users sitting or standing. Having high contrast characteristic of the map taking place on the reception desk and helping to find places and having sense of touch provide information which can be reached for all visitors also covering the users who have visual restrictions.

3. Conditions for privacy, safety and security must be in the equality which can be obtained by all users.
4. Design must be presented to all users with the same attraction.

Figure 2.

Transparent space in vertical direction opened on swinging door taking place in Figure 2 of the first sample provides safe entry and exit for all users having different tallness. Gradual deepening of the swimming pool taking place in the second sample provides the possibility for the pool to be used by the kids who are learning swimming anew and also to the users who have restrictions in moving.

2. FLEXIBILITY IN USE

The flexibility in use provides the design to include a wide content consisting of personal choices and skills of the user. It is required for the users to select the suitable one for themselves. Guidelines of principles (Wolfang and Ostroff, 2001):

1. The right of selection must be provided in the design for the users.
2. In access and using, design must give the possibility for the users to be used both by right and left hand.

Figure 3.

Buttons taking place in front of the kitchen sink seen in the first sample taking place in Figure 3, provide the users to use the kitchen sink by standing or sitting by providing the adjustment of the height. Scissors taking place in the second sample have been designed in a way to be used both by right and left hand.

3. Measures must be taken in order to provide the usage of the design correctly and with care.

4. Design must have the capability to comply with the pace of the users.

Figure 4. Examples of Guideline 3 and Guideline 4. (*http://www.future call.com/picturespeakerphone40dbf c-2511.aspx*, *http://www.payphone-project.com/news/2013/03/paypho nes-of-the-future-y2k-style.html)*

Figure 4.

Telephone seen in the first example taking place in Figure 4 with its dialing keys with photograph and big-spaced buttons for the number keys is suitable with for the users who can not see the keys exactly during telephone process and do not have sleight of hand because of having disorder such as arthritis. Audio control and operating instruction characteristic of the public telephone in the second sample assists the users having hearing and seeing difficulty when they use the telephone.

3. SIMPLE AND INTUIVITE USE

Simple and intuitive use makes the design easily understandable without regard to the experience, information, foreign language skills or respective concentration level. The achievement of simplicity in design comes with removing the unnecessary complexity, providing healthy information and creating considering the literacy and foreign language levels. The design shall be simple and easily perceivable to be called as understandable. Guidelines of principles (Wolfang and Ostroff, 2001):

1. Unnecessary complication must be removed in the design.
2. User expectations and intuitions must be taken into account in the design.

Figure 5. Examples of Guideline 1 and Guideline 2. (*http://www.tacophile.com/univers al-design-bathroom-faucets/universal-design-bathroom-faucets-universal-faucet-adapter-with-single-hold/*, *http://www.autoblog.com/photos/c lassic-drive-1988-bmw-m5/#3439107#photo-270515*)

Figure 5.

Battery's way of working by lever shape on and off element seen in Figure 5 can be easily perceived by everybody. Armchair shape design of the control element adjusting the armchair of the automobile in the second sample provides drivers and passengers the possibility to use with intuition.

3. Writing and writing levels and foreign language skills of the users must be considered.

4. In design, it is required to use information order by concentrating according to its importance.

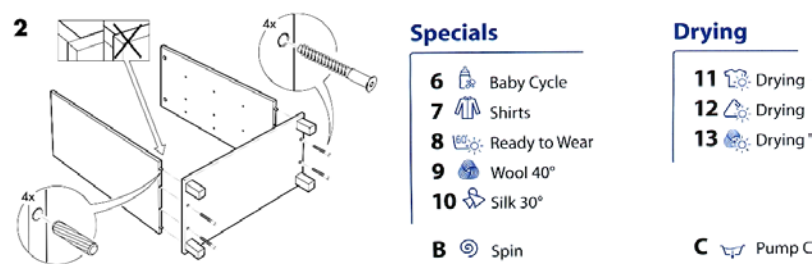**5.** Design must have efficient stimulants put in use during the work or when it ends.

Figure 6.

Assembly information of the imported furniture taking place in the first sample in Figure 6 expressed not only by text but also with clear pictures has eliminated the problems which may arise from the translation of a script. Using visual figures in the washing instruction taking place on the front panel of the washing machine of the second figure provides convenience to the persons who do not know how to use the washing machine.

4. PERCEPTIBLE INFORMATION

Perceivable informing means effectively transferring the information without regarding the surrounding conditions and sensory abilities of the user. The quality of the perceivable informing shall be achieved by use of different styles in information distribution, providing evident and required information in a clear and simple way and supplying accessible information understandable by all persons including the physically disabled individuals. Guidelines of principles (Wolfang and Ostroff, 2001):

1. Different expressions must be used in the briefing required for the design (with picture, sound and the type which can be perceived with the sense of touch).

2. Briefing required for the design must be provided with maximum understandability.

Figure 6. Examples of Guideline 3 and Guideline 4. (*http://www.gunesintamicinde.com/tablet-icin-kataloglar-aslinda-nasil-olmali-ikea-katalogu/*, *http://www.gunesintamicinde.com/tablet-icin-kataloglar-aslinda-nasil-olmali-ikea-katalogu/*)

Figure 7.

Thermostat control element seen in the first sample of Figure 7 covers the characteristics of visual information in interval having two degrees of temperature, specifying with the letter which can be perceived with the sense of touch and stopping done with a sound which can be heard. Contrast characteristics used in the color between the elements, in the brightness and texture in the baby bathtub in the second sample help the families to place their babies in a secure way.

3. Elements used in the design must be separated from each other in a way to be defined. This is realized with directing and forming guidance.
4. Design must bring better solutions than techniques or tools used by the persons who have sensual restrictions.

Figure 8.

Having keyboard and mouse sockets of the computer taking place in the first sample of Figure 8 separated with colors provides convenience in connection. It is in compliance with public telephone hearing means and contains audio control.

5. TOLERANCE FOR ERROR

If the design decreases the accidental and unplanned dangers or bad consequences as much as possible, then it is understood that the error tolerance principle of the universal design is met. The universal design shall protect all the users against the perils and accidents. Guidelines of principles (Wolfang and Ostroff, 2001):

1. Elements used in the design must be arranged in a way to reduce dangers and faults as much as possible. Accessibility must be provided for the most used elements, dangerous elements must be removed, isolated or protection must be provided against these elements.

2. Design must provide warning in the topics of potential dangers and errors.

Figure 9.

Figure 9. Examples of Guideline 1 and Guideline 2. (*http://www.biteofthebest.com/wp-content/uploads/biter2-low-res.jpg, Story, Mueller and Mace, 1998)*

Bread Slicer seen in the first sample of Figure 9 has been designed in a way to protect the hand of user securely from the opening of the knife while grasping the bread. There are warning figures on the cleaning materials taking place in the second sample and these are thought for the kids.

3. Design must provide protection characteristics against potential errors and dangers.

4. Measures limiting the movements in works requiring attention must be developed in the design.

Figure 10.

Figure 10. Examples of Guideline 3 and Guideline 4. (*http://www.wired.com/2010/01/auto-lift-iron-for-absent-minded-sartorialists/*, http://www.akortek.org/assets/dkmpcin_icresim3.jpg)

Iron seen in the first sample of Figure 10 passes to standby mode by the courtesy of its sensor when the hand is taken off from the handle of the iron and then it gets higher on the stands coming out from its base automatically. Thus, risk of burning for the clothes are eliminated and at the same time there is no need to lift the iron and bring it to vertical position when ironing. This feature prevents tiredness on the wrist of the user and at the same time it also eliminates the dangers which may happen when the iron is left and forgotten in horizontal position. Shape and color separation of cable connection elements taking place in the second sample prevents mistakes which may happen during the connection of the compounds.

6. LOW PHYSICAL EFFORT

The low consumption of power means that the users will utilize the products and places by experiencing minimum tiredness and with a high efficiency. To be net and crystal clear, the user shall not repeat the same motions and shall decrease the spent physical power as the use progresses in time. The design products and places should be usable in comfort but spending minimum power and the product/place shall be accessible with minimum power. Guidelines of principles (Wolfang and Ostroff, 2001):

1. Design must give possibility to users to be used with their natural body structures.
2. When design is operated, it must provide using of power in a way not to exceed reasonable levels

Figure 11. Examples of Guideline 1 and Guideline 2.
(*http://www.yankodesign.com/2011/08/03/enchanting-doorlight/*, *http://www.muji.net/foundmuji/flea/item39.html*)
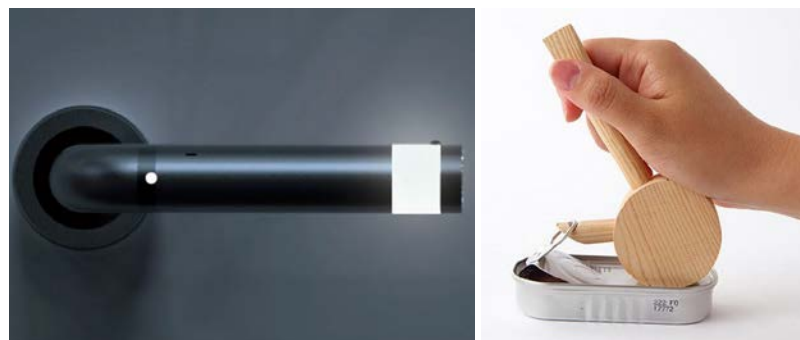

Figure 11.

Door handle in the shape of lever arm seen in the first sample of Figure 11 can be operated with fist or elbow by being different than door handles having the shape of door knob. This feature provides convenience for the old user who have less power in their hands and also for the persons who have difficulties in grasping because of having disorders such as arthritis. Additionally, motion sensing illumination taking place in the end part of the handle make night sensing of the door

easier. Auxiliary element designed to open can products taking place in the second figure provides the possibility to open the products by using minimum power.

3. Repeated movements must be reduced as must as possible.
4. In design, there must be an approach to reduce exertion of power for a long period of time.

Figure 12.

Figure 12. Examples of Guideline 3 and Guideline 4. (*http://i01.i.aliimg.com/wsphoto/v0/1495372521/Car-Washing-4-in-font-b-1-b-font-font-b-Hose-b-font-font-b.jpg*, *http://www.batuhandemirkan.com/resimler/yazi/taga_02.jpg)*

In the first sample taking place in Figure 12, nozzle attached to the end of the hose used for the irrigation of the garden reduces the need to spray the water by being sustained in a way to apply the same power. Baby-carriage seen in the second figure provides the possibility for the parents to take their babies around by using less power and also by getting less tired.

7. SIZE AND SPACE FOR APPROACH AND USE
When dimension and place is provided for the approach and use, the place and the product then meets the needs of all the users without regard to the physical sizes, conditions or dynamism of the user. That is to say, for instance, comfort should be provided for both the sitting or standing user. Also there shall be sufficient space for the assisting tools and personal assistance. Guidelines of principles (Wolfang ve Ostroff, 2001):

1. Unobstructed point of view must be provided for every user sitting or standing for them to see the important elements.
2. Possibility must be provided for every user sitting or standing for them to be able to reach toe important elements.

Figure 13.

Figure 13. Examples of Guideline 1 and Guideline 2. (*Lavine, 2003, Story, Mueller and Mace, 1998)*

Lowered section of the counter seen in the first sample taking place in Figure 13 provides a comfortable point of view for the users having different tallness and also for the users who sit. On the other hand, storage element taking place in the second sample which is used in the kitchens of the residences provides a comfortable point of view for all of the users to be seen by them by the courtesy of its racks which can be pulled out completely and thus enables the contents of the racks seen from different heights and from both sides.

3. Design must be in compliance with different hand sizes and grasping characteristics.
4. Design must provide required area in order to be able to use personal assistance and auxiliary means.

Figure 14. Examples of Guideline 3 and Guideline 4.
(http://www.geeky-gadgets.com/wp-content/uploads/2011/01/Chop-Round-Knife.jpg https://stevemwhite.files.wordpress.com/2013/05/20130530-180649.jpg)

Figure 14.

50

Circle shape handle of the knife used to mince the meat and taking place in the first sample in Figure 14 is suitable to be used by the users who have different hand sizes. Sleeve designed for the sharp part of the knife eliminates the accident which may take place. Wide passing space of the metro station taking place in the second sample provides comfortable passing possibility for the users who use wheelchair, wheeled suitcase and baby-carriage and also for the users carrying their packages.

In order to accomplish correct design with universal design principles, reference is done for all criterion to be provided and at the same time, it must be possible to use the design everywhere at all times. Other important factors such as aesthetics, cost, safety, gender and cultural structure must also be taken into consideration when the design is done. When universal design principles are applied, there must be more importance given to usability.

CONCLUSIONS AND RECOMMENDATIONS

In our age, it is required that physical environment and products must adopt design approach providing equal usage by all of the individuals taking place in the society. Physical environment and products designed according to the needs of

the "Average User", other than handicapped users, also prevent user groups such as the elders, kids, persons with extreme weight, very tall or very short persons, pregnant women and sick persons who are in their tine of recovery. For this reason, all user groups must be taken into consideration in design of physical environment and product. Universal design is the approach style providing development of the products and environment that can be used by all peoples as much as possible. In the concept of universal design, it is aimed that everybody must make use of the same physical solutions as much as possible in using of the buildings, outdoor sites, communication equipment and products.

Due to inequality between the abilities of the user and the possibilities provided by the environment, users are restricted most of the time. This restriction must be overcome through universal design of the products, buildings and environments. Design of environment and products for which the "Average User" is taken as the basis will increase the need for the special design. Realized special solutions shall be generally expensive and more complicated. Usage of all products, buildings and environment in many equal conditions as much as possible takes place on the basis of universal design.

User factor is important in the designs of habitats and products to be used in these mediums. By also covering handicapped persons, participations of all user groups must be provided in different areas of living as much as possible including sheltering, education, working and entertainment without limiting with special solutions or measures. Possibility for the users to use habitats and the sites taking place in the immediate surroundings is related with the realization of the actions done in these sites by them. For this reason, it is important to determine physical characteristics and needs of different user groups. For example, determining maneuver areas for the persons who use auxiliary element in order to move shall be a determinant factor in the design of the sites. In design of living spaces, main purpose must be providing the usage of these areas for all user groups independently without having the help of any other person.

When universal design characteristics propounded in this study are applied, all user groups shall be able to perform all functions required for their lives without needing the help of any other person. Universal design concept must be adapted as the design understanding of the future and in order to be able to apply it in our country, it is required to collect statistical data related with the user groups and researches must be done in relation with this subject. Knowing the needs of all user groups

51

and handling these needs together with the suitable universal solutions will bring useable design understanding with it.

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RESUME

Şenay BODUROĞLU was graduated in the year of 1997 from Architecture Department of Selçuk University. In the year of 2000, he assumed duty as the Researcher in Mimar Sinan Fine Arts University Interior Architecture Department. In the year of 2001, she completed his Post Graduate Thesis and completed his Competence Thesis in Art in the year of 2005. She was appointed as the staff member of Assistant Professor in Interior Architecture Department in the year of 2006. She recently continues the same duty.

53