



Creativity + Innovation & Technology

#### O-CITY PROJECT



Erasmus+

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## Topic 1 - Lesson 1. User-Centered Design

This lesson is prepared with the aim of introducing students to the main topics of the design process that should be applied when creating an infographic.

This document contains an overview and an analysis of the most used theories and methodologies for the design of information visualizations and user interfaces, that necessarily present organized and structured visual elements.

Specifically, explicit reference is made to the Usability and the User-Centered Design methodology, as their goal is optimizing the User eXperience (UX). Indeed, in designing infographics and user interfaces, clearly organized and visualized information and data are needed, to allow the users having a smooth and fluent navigation experience in digital and physical information environments, such as a museum website, an exhibition, or a nature park.

### Design process and Usability

When we talk about User-Centered Design (UCD), we are fully part of a broader methodology called Human-Centered Design, defined within the ISO 13407 standard as follows:

Human-Centered Design is an approach to the development of interactive systems specifically oriented towards the creation of usable systems. It is a multi-disciplinary activity that incorporates knowledge and techniques of human factors and ergonomics. [...] Applying ergonomics to system design requires that human abilities, skills, limitations and needs have to be taken into account. Human-Centered systems support users and motivate them to learn. The general benefits can include increased productivity, a better quality of work, reduced support and training costs, and improved user satisfaction.

This approach aims to consider the needs and wants of end-users throughout the design process, from the earliest stages.

In summary, while traditional design approaches focus attention on the system and its functional requirements, User-Centered Design studies and analyzes the characteristics, needs and habits of the user, identifying the various contexts in which the system will be used and, through the definition of use cases, identifying the tasks that the user, or the various types of users, will have to perform through the system. This approach naturally leads to the identification of suitable interactions between the user and the system, as the first is the starting point for designing the second.

User-Centered Design is the methodology that places the user at the center of the design and evaluation process to create services and products that are not only simple to use but also pleasant and appealing, consistent with their needs and expectations, capable of creating and anticipating desires.

That means that when you organize and model interactions and User Interfaces, that includes designing the structure and flows of information, data, functions, etc., you always

have your user in mind. Indeed, you do not define the requirements by yourself, but you have to really understand the user needs, the goals and even the context of the use of the interaction, by gathering data with research and statistics tools.

For example, when the users of the physical and virtual museum are kids, visual information and contents have to be adequate to their capabilities and needs. So, it could be better to limit textual contents and guide them in every step of the different activities and resources offered by the museum.

In the same way, specific apps are created to let kids learn about the collection of a museum by presenting them in a more engaging and accessible way, i.e. with visual elements and targeted information.

Here it is possible to see the contents produced for kids by the National Gallery of Art, in London: <https://www.nga.gov/education/kids.html>



Fig. 1 - NGAkids Art Zone for iPad (Source: [National Gallery of Art, London](http://www.nationalgallery.org.uk))

Another reason for applying the design process to user interface and information design is the creation of a proper user experience.

Nowadays, many documents of our cultural and natural heritage are available in the form of digital resources, such as data, photos, videos, etc... They can be easily searched and used thanks to interactive tools and user interfaces helping us in managing large datasets

by using a visual language. However, users need to easily understand and be able to find the information they are looking for in the interactive archive.

For example, following up on its policy of opening up cultural data, the French department of Hauts-de-Seine chose to share a large iconographic collection in open data, following a ten-year scanning and documentation campaign conducted by the Musée Albert-Kahn. Access to this exceptional collection was made possible through the use of the Hauts-de-Seine Open Data portal (available in French), powered by Opendatasoft.



Fig. 2 - Home page of the Hauts-de-Seine Open Data portal with a visual representation of the main categories of the available datasets (Source: <https://opendata.hauts-de-seine.fr/page/accueil/>)

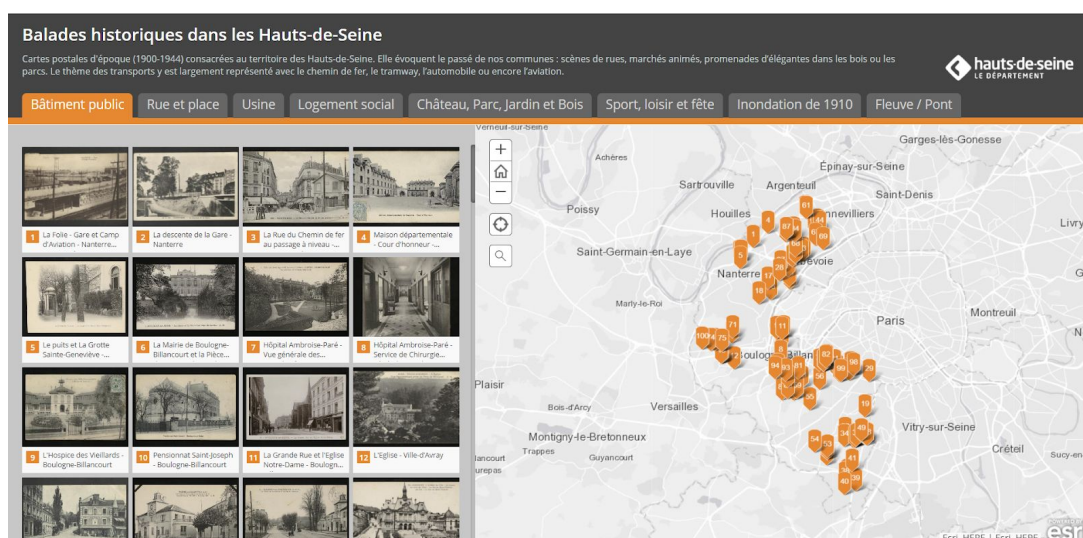


Fig.3 - Storymap about the city made by using the open data about the cultural heritage (vintage postcards) resources of the Departmental Archives (Source: <https://opendata.hauts-de-seine.fr/explore/dataset/cartes-postales/information/>; <https://hauts-de-seine.maps.arcgis.com/apps/Shortlist/index.html?appid=8fb11c960527496d9e7ee9abeb9ddc7b>).

Visual content and information design are fundamental in creating a satisfying user experience for physical museums, too. In this regard, it is important to consider how the integration of physical and digital spaces could support the user in finding the right and desired information.

For example, the “Museum visit planner” of The Natural History Museum in London is an app that supports visitors in creating the best itinerary to visit the museum based on their specific interests. It mainly uses visual contents (i.e. icons and images) to create the interaction between the user and the system.

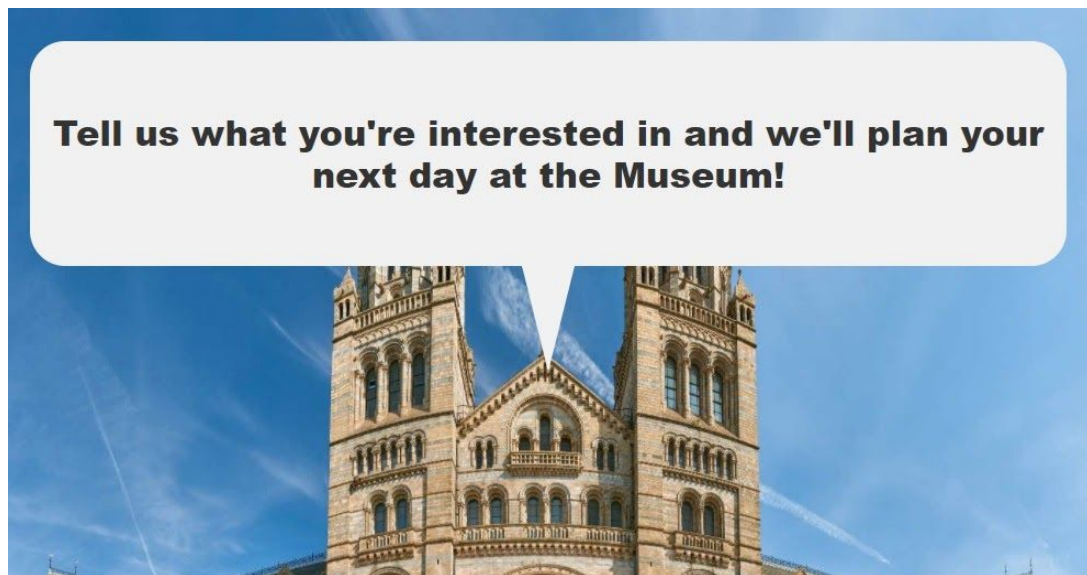


Fig. 4 - Screen of the app “Museum visit planner” created by The Natural History Museum in London (Source: <https://www.nhm.ac.uk/visit/build-your-plan/>)

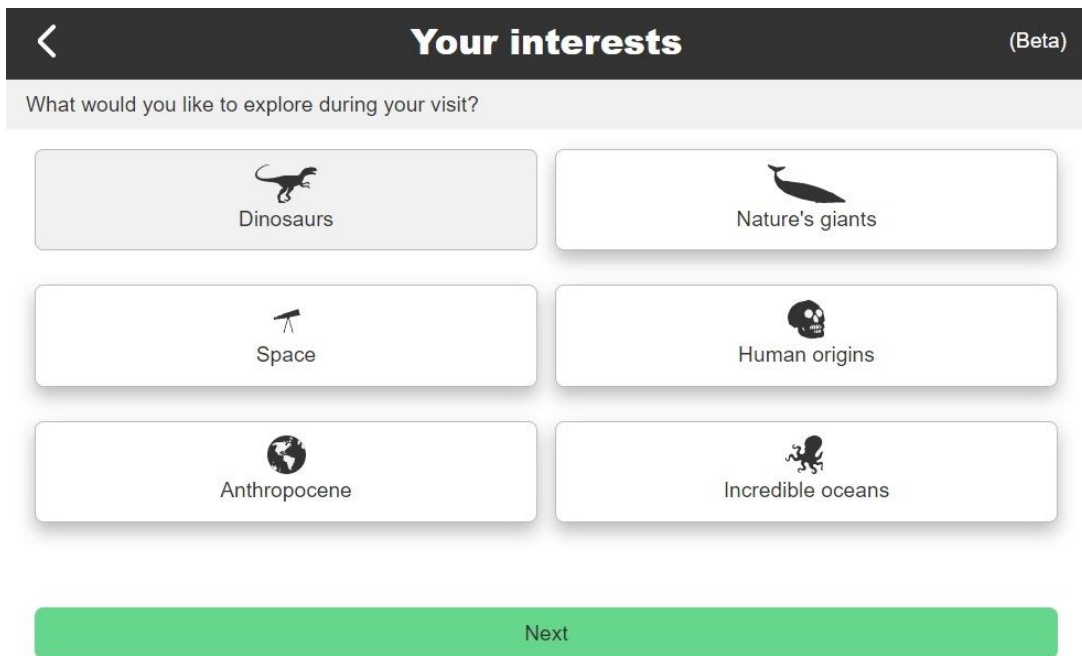


Fig. 5 - Screen of the app “Museum visit planner” created by The Natural History Museum in London (Source: <https://www.nhm.ac.uk/visit/build-your-plan/>)

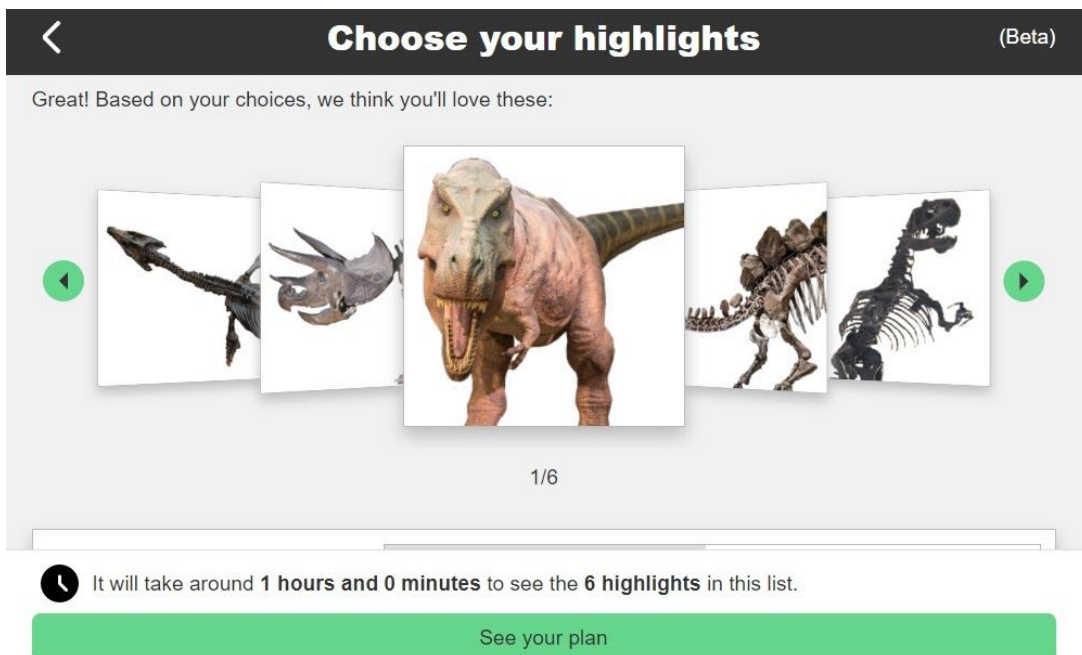


Fig. 6 - Screen of the app “Museum visit planner” created by The Natural History Museum in London (Source: <https://www.nhm.ac.uk/visit/build-your-plan/>)

One of the main aspects to take into consideration during the design process for the creation of a good experience is its quality of use. This aspect is so important that its parameters are defined in the ISO 9126 standard (Information Technology - Software

Product Evaluation - Quality Characteristics and Guidelines for their Use), with particular reference to the usability of the software.

The term "usability" refers to the definition provided in the technical standards UNI EN ISO 9241-11: 2002, ISO 20282: 2006 and UNI 11377: 2010 as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use".

The degree of effectiveness, efficiency and satisfaction in using a product is verified by techniques, tools and methods of investigation in line with the above mentioned technical standards and in particular with the parameters defined for usability in the ISO 13407: 1999 standard (Human-Centered Design processes for interactive systems):

- "Effectiveness" is the accuracy and completeness with which users achieve specific goals. Indicators of effectiveness include, for example, the number of tasks completed and errors occurred in completing a task;
- "Efficiency" refers to the resources spent in relation to the accuracy and completeness with which users achieve results (i.e. effectiveness). Indicators of efficiency include the time spent by users in finding and understanding specific contents and completing tasks;
- "Satisfaction of use" is the comfort with and the positive attitude towards the use of the product (or system).

According to the design expert Donald Norman, the main problems in the interaction between machines and people arises because people work better when signals and information reflect their way of perceiving and thinking, that is similar to the real world. On the contrary, machines work at their best when signals and information reflect their way of operating, i.e. a digital, rigid, precise way.<sup>1</sup> That is why usability and UX are important aspects to consider when the two subjects are forced to meet.

Measuring the usability of an interface is far from a simple problem since it is necessary to take into consideration all the different aspects of the interface that cannot and must not be purely aesthetic:

- The fluidity of interactions;
- The ease and speed of data entry;
- The clarity and responsiveness of the system;
- Intuitiveness and naturalness in the workflow;
- The comprehensibility of information and functionalities;
- A fast and easy learning curve;
- The accuracy of the information presented, in terms of correctness and contextuality;

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<sup>1</sup> D. Norman, The Invisible Computer, MIT press, Cambridge 1988.

- The last point to take into consideration is actually the aesthetics of the interface, that is to say its visual appeal, but always in relation to the context of use.

In detail, the ISO 9241 standard emphasizes that the attributes required by a product to be usable depend on the nature of the user, the task, and the environment. Indeed, a product has no innate usability, only the ability to be used in a particular context. This means that usability cannot be assessed by studying a product or system in isolation.

The design process is cyclical, and consists of four main iterative phases:

1. Specify the context of use: identify the people who will use the product, what they will use it for, in what conditions and how by defining use cases and user profiles.
2. Specify the requirements: identify, if any, the client's requirements and user objectives that should be met by the product to be successful.
3. Create alternative solutions: start from creating low fidelity prototypes (e.g. wireframes) and then raise the level more and more arriving to create mock-ups and interactive prototypes.
4. Evaluate what has been done: this is the most important part, to be carried out through validation tools, usability tests with users and heuristic analysis conducted by experts.

If the results of the evaluation are not satisfactory, the process restarts from the previous stages. Otherwise, the product is ready to be implemented as the requirements are fully met.



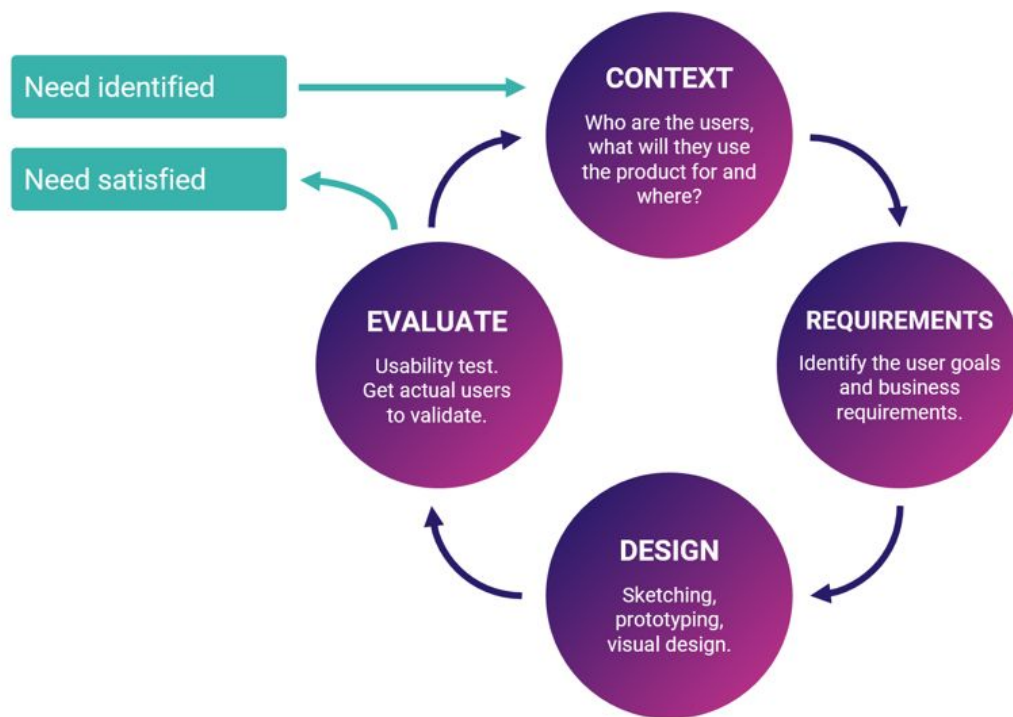


Fig. 7 - User-Centered Design process (Source: [“How user-centred design can help us communicate better with data”](#), by Jon Geraghty).

Beyond user interfaces, User Centered Design (UCD) can be applied to static and interactive data visualizations and infographics, as well as to physical environments, since it helps to focus on what is important: i.e. the users (or visitors).

### Context of use and user needs

From the User-Centered perspective, the first thing to do to start designing the product or system is to identify the type or types of user, specifying their characteristics, wants and needs. For example, in the case of infographic and data visualization, it is fundamental to know what activity the user would do on the basis of the information acquired or of the dataset at his/her disposal (goal), but is also fundamental to know his/her level of visual literacy.

Equal importance should be attributed to the context (where and when) and the possible situations in which the product or system will be used (or located in the case of a physical infographic, such as a poster or an informative panel). The context of use should be analyzed in order to have a broader and more precise picture of every factor that can affect the user during the interaction.

To identify the user's needs (even those of which he/she is unaware) it is necessary to understand his/her models and mental representations, observing how the user does a

certain activity and how he/she would like to do it. All this should be done by choosing one or more methods and analysis tools, selected according to the way the designer decides to conduct the data collection and analysis (type of data to gather, type of participants, existing constraints, etc.). The resulting research data, duly evaluated, will give the key insights for defining the requirements that the system should have in accordance with the user needs and goals (User Requirement).

It is useless and counterproductive to simply ask the client (or user) about what to do or plan since people are able to describe (badly) only what they actually know and are absolutely unable to discern between what they want and what they actually need.

The identification of user needs and the resulting requirements can be done using different tools that can be combined to obtain real and effective insights about people.

In details, the research tools that can be used include:

- Quantitative surveys, such as structured (closed-ended questions) interviews and questionnaires administered through telephone, online tools or paper, or face-to-face. The questionnaires can be also semi-structured (open questions within a series of pre-established options) or unstructured (open questions).
- Qualitative surveys, such as interviews and focus groups that allow in-depth research within a group of people considered representative of the target one or more aspects relating to the project to be implemented.
- Field observations, carried out in order to collect information to understand the context in which the user's activities take place.
- Analysis of competitors and best practices, which make it possible to identify the best solutions adopted in the sector of interest, to highlight their strengths and weaknesses and propose a product that is adequately positioned on the market.

## Requirements

On the basis of the user needs and requirements, the functions and attributes that the final product should have are clearly defined, along with how the system should behave from the point of view of the user. The features of the system are strongly related to the users' goals, activities, habits and to the context of use in which the activity takes place.

The functional requirements are the requirements related to the interactive services that a website or mobile application should make available to its users. In general, they describe the functionality of the system for the different categories of users.

The most used technique to define the required functionalities is represented by the use case diagram (or user flow) that describes a set of interactions between one or more actors in the system in order to meet a goal. A use case or scenario is initiated by an actor for a specific purpose and ends when it has been achieved. For each purpose, a sequence of interactions (operations and sub-operations) is defined focusing on what the user needs

to get done, with the aim of delivering that in the most effective and efficient manner possible.

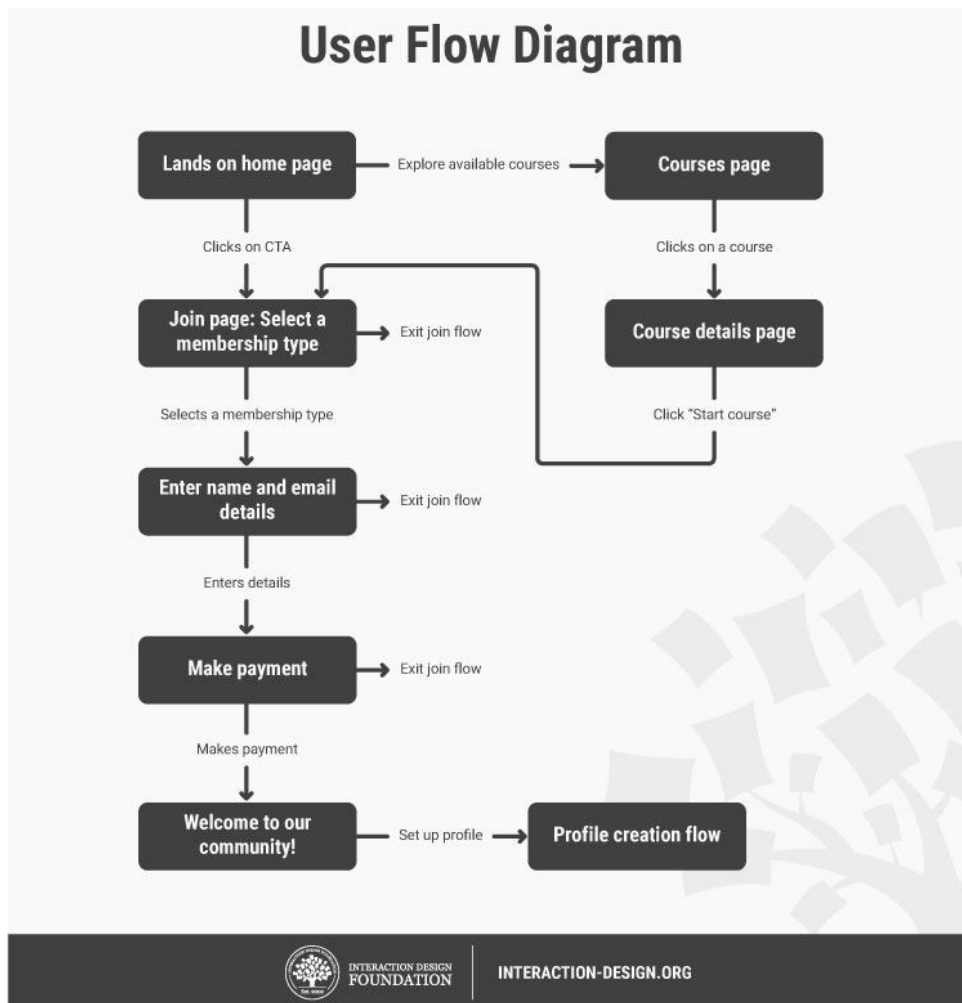


Fig. 8 - Example of User Flow (Copyright holder: Teo Yu Siang and [Interaction Design Foundation](https://www.interaction-design.org/). Copyright terms and licence: CC BY-NC-SA 3.0)

The same principles and phases can be easily applied to the design of interactive visualization of information or data. Even when designing static representation of information, you should define which features the infographic should have to satisfy the user goals and needs (e.g., is the format appropriate to the context of use and the user profile? What kind and amount of information is needed? Are people going to see all the content or only some parts of it? Which features are desirable for the users? Which path the user should follow in reading the information?).

Another very widespread technique for organizing and structuring digital and physical information environments is "card sorting" that helps in a grouping, prioritizing and

structuring the content based on user input. With this particular technique, it is possible to create an information architecture based on information categories with intuitive, easily understandable, easy to search and findable labels.

Card sorting can also be used as an evaluation technique for validating the designer choices. In fact, users can be involved from the early stages in the different phases of the design process for giving their feedback through focus groups, interviews, questionnaires, and more specific tests aiming to understand if the design solution meets the identified requirements and the user needs.

## **Conclusions**

The concepts learned in this lesson will allow us to design the infographic, and more in general user interfaces, following a User-Centered Design process.