User experience design

Tom Hancocks [1]

- Cross-domain
- Beginner
- Intermediate
- 1 hour

This course introduces user experience design (UXD) in the context of bioinformatics tools and service development. It provides an overview of basic concepts and links to external resources on UXD where you can learn more.

Learning objectives:

- Explain the concept of UXD
- Comprehend the benefits of conducting UXD
- Describe different approaches to undertaking UXD

What is user experience design?

User experience is somewhat intangible, and perhaps unmeasurable, but there are a number of useful models that can help us consider the experience that someone has when they interact with, for example, a device or a website.
Figure 1 The "user experience honeycomb" [2], devised by Peter Morville.

For EMBL-EBI, there are other elements that can be added to the honeycomb. These additions cover software properties that our user require or expect when interfacing with our webpages, data and scientific tools.
Elements of user experience

An alternative view of user experience was suggested by Jesse James Garrett and is shown below. Click on the image to open it in a larger size.
Practically speaking, in the domain of biosciences at least, user experience design is about making services and products that help researchers do their work; that provide utility, and access to huge archives of biological data; that work smoothly and don't get in the way.

In order to do this, we need to learn about real context-of-use: what are researchers trying to do? How do they describe their work? Where do they work? What challenges do they face? What workarounds do they use? Doing what we can to answer these questions gives us a solid foundation for building products for the scientific community.

How UXD solves problems

By taking a deeper view of how we design things, and by basing our choices on a sound understanding of how people work and what they are trying to achieve, we can work towards building scientific services and tools that provide real value to the community, and that don't get in the way of research activities.

From learning about and understanding both users and project leaders, through to working on structure, content, and interaction design, and the iteratively adapting our design based on testing, user experience design can help have a holistic view of the things we work on.
UX design is a phrase with a very broad definition. The above figure provides a useful way to think about it as an umbrella term that covers a range of activities and skillsets. Sometimes though, “user experience design” can seem like such a broad term that it is meaningless; but nevertheless, it is a useful label.

Who conducts UXD?

Within the scientific domain, it is still quite rare to have dedicated user experience design professionals involved in projects, so it often falls to someone to lead in terms of design thinking, and to advocate for the users. That might be you!

Without a foundation of understanding, and without validation by your user community, how will you know if all your hard work is producing something of value to them? If you don’t advocate for the user, who will?

In reality, we are all responsible for the design of services and applications. As soon as we make choices about how to make something, we are affecting the end design. So the design process — from where we begin to explore an idea to where we deliver viable solutions — benefits from being as inclusive as possible.

The phases of design
Originally proposed by the UK Design Council, the "Double Diamond [6]" model provides a useful way to consider the broad flow of user experience design work, and its different phases.

Figure 5 Adaptation of the UK Design Council's "Double Diamond [6]" by Francis Rowland.

In reality, the process of designing a service or product isn’t as clean cut as this: phases blend into one another; things adapt and change as we continue to learn about how products are being used; there are constraints of time and resources. Even so, if we try to include people in the design process, we communicate about progress and findings, and we remain focused on a clear understanding of problems and goals, then we are more likely to be able to design something of value.

The first phase is DISCOVERY

Here, we begin to learn about the subject area, about user behaviour, about project stakeholder goals and assumptions, and we start to build up a foundation of understanding. A divergence of approaches and of thinking is encouraged here. Be open-minded.

The next phase is DEFINITION

We take what we have learned, and we begin to converge on a clearer definition of what it is that we’re trying to achieve. We can define and document our understanding of user needs, of project goals, of our proposed next steps and how we expect to identify success.

Then we have DEVELOPMENT

This is often where projects start! This can be risky if there is a poorly defined focus and little idea of how to test assumptions and validate success. So here, we try to build, literally, on our foundations of Discovery and Definition.
and we begin to make things that may become the solutions that we finally deliver to users. Here, we again strive for divergent approaches and thinking, and we continue to test our assumptions and validate our understanding.

Finally, we have DELIVERY

Through iteration and validation, we begin to refine our concepts, and to consolidate them into more tangible, testable prototypes, again being prepared to test and iterate. We converge on something that we deliver; that we make live. The design process doesn’t stop here though; it cannot be a case of “fire and forget”. We must start to think about the sustainability of services and applications, and to assess their success once they are being put to work by users.

Discovery

Here, we begin to learn about the subject area, about user behaviour, about project stakeholder goals and assumptions, and we start to build up a foundation of understanding. A divergence of approaches and of thinking is encouraged here. Be open-minded.

Typically when we begin a project, our concepts, ideas, and understanding are quite fuzzy, and require some definition and refinement. We may also have assumptions or hypotheses about the behaviour and needs of users. There are a number of research approaches that we can use to discover more about our user and their goals. Christian Rohrer shows when to use different research methods [7] to learn more about users.

Surveys [8] provide a way of learning about attitudes and reported behaviour. They can offer an additional perspective in terms of user research, and allow you to mix both qualitative and quantitative knowledge. Good surveys are often preceded by targeted interviews, so that the survey itself can be better designed.

If you are redesigning an existing product, such as an online service or application, you may be able to draw on analytics [9] data [10] to tell you something about current use and common patterns or trends.

While reports and analytics can tell you about what and how, only getting out of the building and having contact with users will help you learn about why. By getting away from our desks and offices, we can learn through observation, begin to better understand context of use, and develop empathy with our users.

Two effective approaches are interviews [11] and shadowing [12] (a particular approach to contextual enquiry). These allow you to learn about people’s attitudes and behaviour through direct observation, preferably where they are, so that you can learn as much as possible about their context.

Interpreting your discoveries

Surveys, interviews and other means of discovery can generate a lot of information to work with, and you typically need to spend some time analysing that information and then synthesising something useful from it.

Some of the techniques that you can use for this include interpreting information from interviews and visualising it in an empathy map [13].

You can take many fragments of understanding, and begin to piece them together into a rich picture [14] - something that can help you visualise and discuss overall understanding of a subject or design problem.

It can often be very informative to visualise some of what you learn as journey maps [15]. Journey maps provide a means of understanding someone’s experience of using a particular service or application. Particularly in a scientific setting, it can be useful to understand the relationships and hand-offs between the different people...
engaged in research, and to represent these visually, too.

All of these serve to refine your understanding of a project, and move towards a more defined view of the work ahead.

Figure 6 A photo of a researcher’s desk. Carrying out interviews and observations where someone works helps us to learn more about the context of how and why they work the way they do. Photo courtesy of Francis Rowland.

Definition

We take what we have learned, and we begin to converge on a clearer definition of what it is that we’re trying to achieve. We can define and document our understanding of user needs, of project goals, of our proposed next steps and how we expect to identify success.

We can take what we have learned in the early phase of discovery, and use that to define the project in a clearer way. This becomes the foundation and the reference point for the next phases of work.

We need to be able to frame the design work, so that we are better able to make choices, and more confident that we can balance project goals and user needs.

It is well worth taking the time to explore, understand and then describe the design problem we want to focus on in
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A problem statement [16] is a summary of what we believe a project needs to achieve, informed by the research we have done in the Discovery phase with stakeholders and users.

Related to this, it can be a valuable exercise to create a set of design principles (see the UK Government's Digital Service examples [17]) from your understanding of a given project. These should not be adjectives that are simply made up, proclaimed, and then forgotten. Rather, they should be drawn from what you have heard in your research. What is important to people, and how can you retain awareness of that as the project unfolds?

Defining user needs

Personas and scenarios [18] can be a useful way to help a team of people remain conscious of the users for whom they are making something. Personas describe archetypal users (their behaviour; their abilities; their goals; their pain points; etc.), and are ideally based on data you have collected through research. They become especially useful when they are considered in the setting of particular representative scenarios. Again, these scenarios should represent thing that you have observed or things that have been discussed in interviews.

Figure 6 EMBL-EBI persona created to better understand our "power users".

If we consider the complex setting in which many scientific services and applications are used, then it can also be useful to characterise important activities [19] that users from different domains all need to perform.
At this stage in a project, it is a good idea to consider how you will know if what you are making and testing will later be successful. What will indicate to you that you are on the right path to delivering discernible value to your users?

This is not simply about collecting metrics – these numbers need to be attached to defined objectives. You might consider using the Objectives and Key Results (OKR) approach, or you may prefer to consider the HEART methodology developed at Google Ventures.

Consider co-creating a single document, such as a design plan, to capture some of the key objectives and principles in one place. This should be a simple, shareable reference point for anyone involved in the project.

**Development**

*This is often where projects start! This can be risky if there is a poorly-defined focus and little idea of how to test assumptions and validate success. So here, we try to build, literally, on our foundations of Discovery and Definition, and we begin to make things that may become the solutions that we finally deliver to users. Here, we again strive for divergent approaches and thinking, and we continue to test our assumptions and validate our understanding.*

This is where concepts and plans become more tangible. It is a good idea to start with sketching on paper - it provides a fast, low-risk way to generate lots of concepts, validate them, iterate, and refine - before choosing a particular direction.

Sketching allows many degrees of flexibility - whether it is done individually, in pairs, or in groups - it is a productive, adaptable way to begin working with concepts.

From there, if you're working on applications or websites, you might begin to make prototypes using digital tools - things like Balsamiq, Keynote, Powerpoint offer lots of possibilities, and of course HTML/CSS/JS.

You can validate your concepts using approaches such as structured critique from colleagues and domain experts, and through usability testing with representative users. It is never too early to start doing this! Learn fast, learn often, and be ready to adapt your designs and change course if necessary.
Consider following iterative (and not incremental) cycles of **Build > Test > Report > Learn**, so that you maximise the impact of what you observe in validation, and feed this back into the development process. It can be helpful to think of your sketches and prototypes as experiments that allow you to test a hypothesis: you don’t have to get it right first time.

And in all this, continue to work closely with those involved in delivering the final product - inclusion and communication make good design much more likely to thrive.

**Delivery**

*Through iteration and validation, we begin to refine our concepts, and to consolidate them into more tangible, testable prototypes, again being prepared to test and iterate. We converge on something that we deliver; that we make live. The design process doesn’t stop here though; it cannot be a case of “fire and forget”. We must start to think about the sustainability of services and applications, and to assess their success once they are being put to work by users.*

As you continue the development of viable, valuable solutions and look at how to deliver these to users, it is important to consider how you are going to assess their impact. Look back at the indicators of success you worked on in the Definition phase.

There is often a refinement of our prototypes at this stage, frequently influenced by further usability testing, though we may still use sketching to explore possibilities and to deepen our understanding.

Here, our work is often even more closely intertwined with that of the development teams, and so we need to find a constructive way to work together, so that we can deliver something of value, monitor it once it is in use, and then be able to adapt and modify as required.
UXD use cases

The next pages present example use cases showcasing how UXD has been utilised to improve the design of bioinformatics tools and services. Problem statements for the Open Targets (formerly CTTV) project and the EMBL-EBI website design are given below. Two of the uses cases are outlined below.

Open Targets [32] is an exciting, ambitious partnership between the EBI, the Sanger Institute, and GlaxoSmithKline, Biogen, Takeda and Celgene. Amongst its aims, the partnership wants to provide a publicly accessible, pre-competitive platform that will allow researchers to use data integrated from numerous sources to better understand the relationship between genes and diseases.

UX designers were involved from the very start of this project, to help develop requirements, goals, and a design brief for the project team to work with, as well as ongoing data visualisation design, prototyping, testing, and user experience analysis.
As the data resources at EMBL-EBI have continued to grow, the portfolio of services that it offers to the life sciences community has also grown. In terms of visual design and interaction paradigms, things had started to fragment to a certain extent, and some of the “EBI-ness” of services was less clear.

This redesign project tackled these issues in a comprehensive way, with the aim of producing a more unified, consistent online experience of the EBI and its services.

The Universal Protein Resource (UniProt) is a comprehensive resource for protein sequence and annotation data. In 2015 UniProt launched a new website aimed at making user interaction as easy as possible. In this, and the next two slides, Sangya Pundir explains the changes the UniProt developers made to improve the experience of users of the resource.

Open Targets

The presentation below demonstrates how UXD was used during the design stages of the Open Targets (previously CTTV) project for drug target validation.

A UX Journey into the World of Early Drug Discovery from Jennifer Cham

For more on the approach to designing the Open Targets platform you can read ‘Designing an intuitive web application for drug discovery scientists’.

EMBL-EBI website

Design principles

The comment below is taken from a style guide document created as part of the redesign of the EBI website in 2012.

"Our website redesign puts the user first. It recognises that the main purpose of the EBI website is to allow life-science researchers to play with biological data. We do have other types of user: there are job seekers, scientists looking for opportunities to collaborate, funders and journalists checking out our credentials. We should guide these users to the information that they need. Nevertheless, the main purpose of our website is to let life scientists get their hands on our data and do something interesting, new and exciting with them."
The four main principles behind the redesign were:

- **Intuitive** - ensuring the website is simple and easy to use
- **Supportive** - permits users to do what they want to do with data
- **Clear** - universal vocabulary and iconography
- **Responsive** - recognising that user needs will change over time

**Improving online experience**

Click on the image below to explore a poster presented by Jenny Cham at the ISMB/ECCB 2013 conference in Berlin, 19-23 July 2013 - [Poster B44](#) [39].

![Poster B44](#)

**Figure 9** Improving the EMBL-EBI online experience, Jennifer Cham. [Click to enlarge](#) [40].

**UniProt homepage**

This page, and the next two pages, explain changes made to the [UniProt](#) resource. The key design goals for the homepage were aimed at:
- Creating better visibility for all UniProt datasets. These were previously presented in a table and users often don't read text.
- Creating a navigation structure with separation between the search and tools like BLAST, Align and Retrieve/ID mapping. The search and the three tools were previously presented as tabs.
- Streamlining the search workflow, making the dataset selection more noticeable so that when users clicked into a different dataset, they would realise that the search focus had changed too.

Figure 10 The old UniProt homepage.
Figure 11 The new UniProt homepage.

UniProt search results

When a user has conducted a search from the homepage, they are taken to a page displaying the query results. Key design goals for this page were:

- Structuring and presenting filters in an intuitive manner.
- The behaviour of the action buttons and the basket was sometimes confusing and the positioning meant that they sometimes went unnoticed.
- Creating an obvious entry point to customising the columns in the results page.
Figure 12 Search results for "insulin AND organism:"Homo sapiens (Human) [9606]" [42].

**UniProt protein entry**

Once a user has found a UniProt result of interest they click through to a protein entry page. The key design goals for this page were:

- Creating a more intuitive information architecture so that users would be able to better understand where to find the information they were looking for.
- Creating a more visible and effective navigation bar as the pages can be quite long with a lot of information.
- Presenting evidence for the data in an intuitive and easily accessible manner.
Your feedback

Please tell us what you thought about this course. Your feedback is invaluable and helps us to improve our courses and thus enhance your learning experience.

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References

Below are a number of papers that cover UXD in the field of bioinformatics:


Resources

Design Council [48]

The Design Council advise the UK government on design and aim to promote the use of success design practices
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in the UK. Their website summarises the process used by successful companies in the design of their products. The ‘double diamond’ model presented emphasises the point that the initial phases of the design process (discovery and definition) are as resource intensive as the later phases (development and delivery).

**Usability Net** [49]
Usability Net is a EU-funded project providing resources to improve usability and promote user-centred design. Their website includes tools and information on design, as well as contacts for professional groups and a forum. The methods table can assist developers in identifying appropriate methods to use, based on the stage of the project.

**EMBL-EBI user interfaces blog** [50]
A forum from EMBL-EBI for developers and designers of websites, interfaces and visualisation tools aimed at life scientists.

- [Designing better web experiences for bioinformatics](#) [51]
- [User research plans](#) [52]

**UX for Devs Manifesto** [53]
This article published in July 2012 by “design technologist”, Ambrose Little, provides a simple manifesto aimed at developers, and describes the importance of their role in the design process.

**UX Tool Kit for the Life Sciences** [54]
A tool kit created by the User Experience community that enables businesses to adopt UX principles when they develop scientific software.

**There is no UX** [55]
Blog article from Leisa Reichelt, Head of Research at the UK Government Digital Service.

**Further reading**

**Paper prototyping**

**Don’t Make Me Think**

**Universal Principles of Design**

**Prototyping**

**Undercover User Experience Design**
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A Project Guide to UX Design

The User Experience Team of One

Communicating the User Experience

The Elements of User Experience

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Francis Rowland [56]
EMBL-EBI
Lead User Experience Designer - Web development

Francis user experience (UX) designer in the EBI's core Web Development team, where he works across a range of projects, guiding colleagues throughout the design process.

He tries to make things less complicated for people to use.
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Sangya Pundir [57]
EMBL-EBI
User Experience Manager - Martin team: UniProt development

Sangya Pundir is a User Experience (UX) Manager in EMBL-EBI's UniProt team, where she established a user-centred process for the redesign of the world’s leading protein resource. To make UniProt easy for researchers to explore, Sangya conducts usability testing and information-gathering methods such as card sorting, contextual studies and workshops. Before she came to EMBL-EBI, Sangya worked at a healthcare consultancy, designing bespoke management systems. She holds an MSc in Biotechnology, Bioprocessing and Business Management from the University of Warwick.

Cath Brooksbank [58]
EMBL-EBI
Head of the EMBL-EBI Training Programme

Cath joined EMBL-EBI in 2002 to develop the outreach programme, and extended her responsibilities to include training in 2006. Her team now coordinates a wide-ranging portfolio of training activities reaching tens of thousands of individuals each year. She contributes to a number of international projects including CABANA [59] (which she leads), RILtrain [60], CORBEL [61] and BioExcel [62]. She is co-chair of the Education Committee for the International Society of Computational Biology [63] and a member of the advisory board for the Crick African Network [64]. Before joining EMBL-EBI, Cath spent a decade as an editor of scientific review journals, cutting her teeth with the Elsevier Trends Journals before launching Nature Reviews Cancer. Prior to that, a brief dalliance with medicine at the University of Oxford led her to seek solace in molecules in Cambridge, where she completed her PhD in biochemistry under the guidance of Robin Irvine.

Tom Hancocks [1]
EMBL-EBI
Scientific Training Officer - BioMedBridges

Tom Hancocks works as a Scientific Training Officer for the Training Team at EMBL-EBI.
He studied Human Genetics at the University of Leeds and McMaster University in Hamilton, Ontario; before completing an MSc in Analytical Genomics at the University of Birmingham.

Tom has worked for the NHS in diagnostic genetics and as a bioinformatics trainer for healthcare scientists and clinicians.

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**Links**

[1] [https://www.ebi.ac.uk/training/online/trainers/Tom](https://www.ebi.ac.uk/training/online/trainers/Tom)
[2] [http://semanticstudios.com/user_experience_design/](http://semanticstudios.com/user_experience_design/)
[5] [http://www.slideshare.net/uxcrank/the-ux-umbrella](http://www.slideshare.net/uxcrank/the-ux-umbrella)
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