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An introduction to interaction design

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Introduction

Interactive products are the stuff of everyday life for many people, from apps, phones and business systems to wearables, the Web and the Internet of Things. But how can interactions be designed to best meet their purposes and offer good user experience (UX)? That's what this free course, *An introduction to interaction design*, discusses.

The purpose of the course is to give you an overview of interaction design and consists of four sections:

1. **What is interaction design?** Covering the scope and importance of interaction design, including the consequences of design flaws.
2. **Goals and principles of user-centred design**Presenting core concepts such as usability and user experience goals and also the principles that underlie good interaction design.
3. **The 'who, what and where' of the design context**Exploring aspects that characterise the user, the nature of the activity in which users are engaging and the environment in which the interaction takes place.
4. **Interaction design activities and methods**Introducing a variety of methods that interaction designers use in order to help create designs that meet the needs of users, and giving an overview of the main activities of interaction design.

This OpenLearn course is an adapted extract from the Open University course *TM356 Interaction Design*.

Learning Outcomes

After studying this course, you should be able to:

- understand what interaction design is, the importance of user-centred design and methods of user information gathering
- understand how the sensory, cognitive and physical capabilities of users inform the design of interactive products
- understand the process of interaction design, including requirements elicitation, prototyping, evaluation and the need for iteration
- analyse and critique the design of interactive products
- select, adapt and apply suitable interaction design approaches and techniques towards the design of an interactive product.

1 What is interaction design

This section introduces *interaction design* – that is, creating the means by which users communicate with different forms of computing technology in order to perform some activity. The section will:

* illustrate the scope of interaction and the importance of interaction design
* draw attention to the importance of the user, the environment and the activities when considering interaction design
* explore the core concepts of usability and user experience
* highlight key activities and characteristics of the design process.

You will learn some basic concepts and vocabulary of interaction design. You'll be asked to reflect on usability and user experience. On a practical level, you will do some simple evaluation.

1.1 The scope of interaction design

A staggering variety of *interactive products* – devices, software and services that support user activities with computing technology – have become embedded in everyday life, enabling all kinds of activities and experiences anywhere and anytime. These interactive products might include computer applications, websites, heating controllers, smart watches, bio-sensing garments, satellite navigation systems, interactive books, social media, computer games, digital hearing aids, advanced driver assistance systems, healthcare technology such as drug delivery systems, mobile applications, web services and many more.

Figure 1 A man types on an early version of the Apple II personal computer, released in 1977

As computing technology has developed, the nature of users' interaction with technology has changed – and the role of interaction design has expanded accordingly. When computers became small and cheap enough to enter the general market, they became 'personal computers', such as the Apple II (Figure 1). Because of their size and weight, these computers would sit on desktops. Users would interact with them via a keyboard and a small, low-resolution display that showed only text and primitive graphic symbols. Data was stored on magnetic 'floppy disks', and any operations carried out on the data would be slow by today's standards. With these characteristics, these computers could only be used comfortably by one person at a time. All this meant that the experience of the user was relatively simple and straightforward, as well as constrained.

40 years later, computers don't just sit on desktops but have also become embedded in interactive products all around us, on both small and large scales – in our workplaces, homes, cities, transportation or clothes – even in our bodies. Computers such as smartphones and tablets are now so small and light that we can carry them around with us and use them almost everywhere. We no longer rely solely on a keyboard and mouse to communicate with these computers, but we can interact with them through touchscreen or voice, and so our use can be more spontaneous, and we can do many tasks while on the move.

The number of activities for which we use interactive devices has also increased – because the integration of capabilities such as wireless connectivity, high-speed data processing, high-definition graphics, video and sound means that we can use a single device to carry out a range of activities and enjoy a variety of experiences, such as listening to music, watching movies, messaging friends, calling or video conferencing with colleagues, reading books, browsing the internet, taking photos or drawing pictures.

These capabilities mean that computers and the range of applications available for them have become an integral part of our daily lives, often changing the way we do things – for example, the way we access information (see Figure 2), entertain ourselves or socialise. Furthermore, they have expanded the way we explore and experience the world around us.

Figure 2 Close up of someone using touch and gesture to interact with a learning application about white sharks on an iPad

Consider how the interactive maps available on smartphones have changed people's relationship with and experience of their surroundings. Do you remember what it was like trying to find your way around a new city before these came along – having to unfold a large paper map (Figure 3a), find the relevant section, identify your correct position on it, etc.? Now we only have to get our phones out and with a few taps we get to an interactive map (Figure 3b), that shows us exactly where we are, which direction we are moving in, how far we are from where we want to be, what routes we can follow to get there, what other places of interest we could find along the way and even which friends and family might be nearby. Such applications make the world around us available to us in new ways that augment the reality that surrounds us and our experience of it.

(a)   (b)

Figure 3 (a) Couple trying to find their way around in a city by using a paper map; (b) Person using a smartphone with an interactive map to find their way around in a city

It is not just small, personal devices that have entered our daily experience, though. Large, high-quality displays such as multitouch tabletops are enabling people to play and learn together cooperatively. Just as one might exchange real objects, such as documents or photos, digital tabletops make it possible to use similar gestures to manipulate and exchange virtual representations (Figure 4).

Figure 4 Users playing around with a digital tabletop

Table applications may also enable the use of real, instead of virtual, objects to produce visual or acoustic effects on the table's surface (Figure 5).

Figure 5 Users making sounds via a musical tabletop by manipulating and moving digitally enhanced cubes on its surface

Using one's hands or other body parts is no longer the only way of interacting with computers. Headsets that read our brain activity when we think of certain actions enable players of computer games to interact with the game by simply using their minds (Figure 6). These products have not only changed the way in which we can entertain ourselves, but have also enabled people with physical disabilities to control aspects of the world around them, bypassing physical limitations. For example, prototypes of appliances such as blinds and lights have appeared that can be operated by someone's thoughts while they are wearing the headset.

Figure 6 User playing the computer game 'MindFlex' wearing a special EEG headset which captures brainwaves and enables the player to steer a small ball through an obstacle course

Products designed to monitor and interpret what our bodies do have also revolutionised other aspects of human life, for example, healthcare. While in the past, if you wanted to check your heart, you would need to go to a doctor who would use a stethoscope to listen to it (Figure 7a), these days a range of wearable products can monitor vital signs while we go about our daily activities. For example, biometric shirts designed to monitor the vital signs of sports players (Figure 7b) seamlessly embed sensor technology that can measure heart rate, respiration, or motion patterns in real time.

(a) (b)
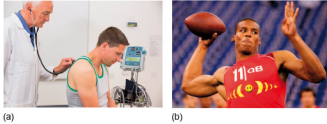
Figure 7 (a) Doctor checking a patient's heartbeat and respiration using a stethoscope in a medical surgery; (b) American football player Cam Newton wearing the Under Armour E39 compression shirt with biometric capability, which monitors vital signs such as his heart and respiration functions during a game

Similarly, many wearable products exist that enable us to keep track of aspects of our behaviour and health, such as how much we exercise, how much energy we consume, how well we sleep at night, and so on. All these products have made more visible, and therefore allowed us to better manage, aspects of our life that might otherwise escape our attention even though they are important for our well-being. Importantly, because they blend in with the clothes we wear or the objects we use daily, these technologies have allowed us to monitor these aspects in real-life contexts.

The capability of wearable products has been used in other ways as well. It has enabled fashion designers to create clothes that can detect the wearer's inner moods in different situations and represent them through changes in the fabric (Figure 8). Imagine wearing one such garment and meeting someone you like: your heart accelerates and your garment lights up in response to your heart rate. Representing our emotional responses so directly and explicitly can change the way in which we interact with others, automatically sharing with them inner states - however they might be interpreted by others - that otherwise would not be so obviously perceivable.

Figure 8 The Bubelle Dress from Philips Design features sensors embedded in its inner lining that monitor the heartbeat of the wearer, which is translated in lighting effects on the outer layer visible to others

Now, imagine if whole rooms or even buildings could be designed to respond to the emotions or behaviours of those who occupy them. In many modern buildings, aspects such as lighting or heating are already capable of adapting to people and their activities, for example, by detecting their presence and switching on or off accordingly. In more experimental buildings, even features such as the shape or decor of rooms can change in response to how they are being used (Figure 9).

Figure 9 dRMM's Sliding House has mobile walls and a roof that glides along rails to

cover its static parts

We are not used to thinking of buildings as dynamic, so living in buildings that adapt to their inhabitants, instead of inhabitants having to adapt to buildings, significantly changes the experience of what it means to inhabit a place.

These examples should give you an idea of how interactive products, both large and small, are changing our experience of and relation to the world around us, to others and even to ourselves. The breadth of interactions is staggering:

- giving us access to everything from tiny single devices to sensor and information networks that span the globe
- supporting activities indoors or outside
- ranging from devices that resemble 'computers' (such as tablets or smartphones) to objects that we don't traditionally think of as computational (such as houses or watches)
- supporting explicit interaction through interfaces we notice (such as touchscreens), or implicit interaction through interfaces we're meant to ignore (such as biometric garments)
- connecting us to objects ranging from those we hold, carry or wear, to those embedded in our homes, our vehicles, our cities.

Interactive products can enable us to experience our world in new ways, augmenting our senses, our attention, and our experience of the world.

1.2 The digital divide

Box 1 A complex phenomenon

Much of what's being discussed in this course is currently only available to a proportion of the world's population. The gap between those with ready access to interactive technology and those with limited or no access is often called the 'digital divide'. There are different aspects to the digital divide.

- There are many people who do not have access to or lack the resources to use interactive technology, due to economic, social or political limitations. For example, it is estimated that 57% of the world's population did not have internet access by the end of 2015 (ITU, 2015) and that 60% of the world's population will have access to mobile phones by 2020 – meaning that 40% will not (GSMA, 2015).
- There are others who do not have the skills, knowledge and abilities to use interactive technology. (How do you design an interactive product for someone with limited literacy?)
- There are others who choose not to use this technology.

Of course, this is a simplified characterisation of a complex phenomenon. This course takes an optimistic view of the potential of interactive technology and its role in people's lives – but we should also be aware of how profoundly people's lives differ.

Over time, the digital divide may lessen, and the proportion of the population that uses interactive technology may grow. The opportunities provided through interaction design advances may also increasingly address the diversity of users. There are many projects that aim to address the digital divide. One is the 'Hole in the Wall' education project (HiWEP, 2011) that made computers available in deprived towns by embedding computers in public walls – and showed that children could learn to use them effectively without instruction. Another is Rwandan Henri Nyakarundi's Mobile Solar Kiosk (MSK), providing low-cost phone charging to users without ready access to electricity supplies. (ARED, 2014).

Figure 10 Indian children queueing to use a 'hole in the wall' computer station

Figure 11 A Mobile Solar Kiosk, which provides low-cost, solar-powered phone charging to users in Rwanda

1.3 Benefits and consequences of interaction design

Although not everyone will wear the Bubelle dress or use an EEG headset to play computer games, technologies such as smartphones and computer tablets are becoming an increasingly significant part of daily life for millions of people. The following activity asks you to try to quantify just how big a part technology plays in daily life.

Activity 1 Exploring daily usage of interactive devices
30-60 minutes

Search the internet for market information or estimates about how many hours adults spend using computers (including laptops and tablets) and smartphones each day. See if you can find figures for more than one country. How accurately do you think these figures reflect your own usage?

In addition to computers and laptops, there is a wide range of other, perhaps less glamorous, interactive products which many people use daily. We may not pay much attention when we use coffee machines, toasters, dishwashers, elevators, automatic doors, car dashboards, vending machines, and so forth, yet without these technologies doing things for us, our daily lives might be very different.

Do you think you are fully aware of the role that interactive technology plays in your life? Below is an activity that will help you answer this question.

Activity 2 My typical day - interactive devices

1 hour

Choose a typical day in your week and a typical hour in that day. Make a note of all the times you use an interactive product, whether it is a phone, tablet or laptop, alarm clock, cash machine or car. If you use a device multiple times, note it each time. For each interaction, note the following information:

- what device you use
- what you use it for
- how long you use it for
- how easy you find the interaction
- whether you enjoy the interaction
- whether you would have noticed the interaction without being asked to think about it.

Take a moment to reflect on what you observed. How typical was this hour? If you look back over the preceding 24 hours, how might it compare? What other devices come into play? How many of the interactions are frustrating or problematic?

This exercise should give you an idea of the time you spend using interactive products and therefore how much a part of your daily experience these interactions are. It should also help you reflect on the range of activities and tasks that interactive technology enables you to do and what difference that makes in your day. Finally, it should help you think about how you experience those interactions – whether the interactive products are readily usable, and what contributes to a good or bad experience using them.

Compile an overview: add up how much time you spent using interactive devices overall, how many devices you used, and how many of those you used repeatedly. Which device did you use the most? Was any interaction particularly frustrating?

Discussion

As a worked example, this is an hour in a typical day in the office complete with an overview of my interaction with a number of these things.

Device and what happens	How often and total duration	What's it like
Phone – gives BBC news notification	Once 1 sec	It beeps in my handbag and is a bit annoying, as the noise of the phone disrupts me from what I'm doing.
Phone – send a message to colleague to check whether meeting is on	Once 1 minute	Good. Quick way of checking things, because starting my email can sometimes take ages due to poor Wi-Fi in my workplace.
Laptop – check whether meeting is on Skype	Once 5 minutes	OK. Depends on whether Wi-Fi is up and running. I can see that other people are not online which is good to know.
Laptop – check email	4 times 20 minutes	Email has become second nature to me. I use it the whole time. I can't remember anymore whether it is a good experience or not – it is what it is.

Door – opening with RFID security tag	6 times 2 minutes	Getting in through the main door is tricky as I have two bags in my hands and find it awkward to swipe the card with my hands full. Later, door access is OK because I've got rid of my heavy bags.
Laptop – open documents in Word	3 times 20 minutes	Opened attachments to mail in Word. Unfortunately Word crashed, so not a very good experience. This has happened a lot to me recently.

Doing this activity makes me realise that I often work with several devices on the go – my laptop and phone are side by side. My phone is my own personal device but I use it for work purposes.

Many of my interactions with normal office applications – Word, email and Skype are not particularly pleasant. I struggle with lousy Wi-Fi, which slows things down – and applications crashing on my machine. Again, not a good experience.

With an application like email, I find it hard to reflect on whether it is a good experience or not, as it is so much a part of my life that I can't distance myself from it to provide an opinion.

The above overview is representative for a working day in the office. Working days can be made more complex by (i) using coffee machines (ii) overhead projectors and other big screens when doing presentations (iii) sharing large files with colleagues through a range of methods. When I am at home, and I do often work from home, a different set of things needs to be added – such as kitchen apparatus.

My laptop is the device I used most of all. It is what I use for all my work, which is reading or writing. However, its use is not straightforward.

If during the above activity you found that you do use interactive products often but take them for granted, that is because the design allows you to focus on what you want to do rather than having to focus on the interaction itself. Yet each interactive product has a user interface, where the interaction between user and interactive product happens, and each interface and interaction has been designed. In other words, good interaction design supports your activities and enables you to do what you want to do easily, quickly and correctly without getting in the way, supporting a natural and engaging interaction between users and products. Unfortunately, not all interactive products meet this standard.

As you might have experienced, there are indeed consequences to poor interaction design. For example, it may take longer to do things, it may be so frustrating that one might give up altogether, or worse it may result in costly mistakes. A poorly designed thermostat may result in users inputting the wrong settings and wasting money on their heating bill.

Poor interaction design may also result in financial losses for companies that use interactive technology during the production of goods. If employees struggle to use their work tools, their productivity may be drastically reduced, thus increasing production costs. Additionally, interactive technology that is difficult to understand and use may also require more training, which also comes at a cost.

At the same time, if a company produces interactive products that are poorly designed, it may incur severe financial losses following the products' commercial failure.

However, the costs of poor interaction design are not limited to daily inconvenience for individual users or financial losses for large organisations. There are numerous instances in which poor interaction design has been responsible for accidents that cost lives. The bad design of interactive products that are used for healthcare purposes, either in emergencies or during routine activities, provides a poignant example. In particular, in the video in the next activity, Professor Harold Thimbleby, an expert in the design of safe interactive medical devices, talks about the importance of good design to prevent or accommodate human error. The video illustrates how even the most trivial interaction errors can lead to tragic consequences, for example, when using blood infusion pumps to administer medical treatment to patients with life-threatening conditions.

Activity 3 Saving lives by design

30 minutes

Watch 'Saving Lives by Design' below and answer the questions that follow.

Video content is not available in this format.

Saving lives by design

a.   What design problem is highlighted with the example of the coast guard emergency phone?

b.   What error did the nurse make when setting the infusion pump and why? Is this a human error or something else?

c.   Which of the two infusion pump designs discussed in the video is safer and why?

Discussion

a.   The coast guard phone sign asks users to do an action (dial 999) for which there is no input device (the only keys are 1, 2 and 3). There is therefore a mismatch between the activity that the user wants to do and the interface, which does not support this activity. When people are using devices with which they are unfamiliar, it is particularly important that they are understandable.

b.   The nurse inputted a drug release rate into the infusion pump that was 24 times higher than it should have been. She used a calculator to calculate the release rate but forgot to divide by the number of hours in the day. The calculator did not know this or what the correct rate should have been, so it did not alert the nurse to the error. Such an error is often considered to be a human error, i.e. something that the user did wrong – rather than an error made by the machine. In this case, the error could have been avoided by an inbuilt calculator specifically for the purpose of this pump. The point of the video is to show how rather than considering such mistakes as human errors, that these are design faults, where the design of the device has not taken on board who will be using it and for what purpose. In the case of medical devices, such design decisions can be a matter of life and death.

c.   The safest pump design was the one that featured up and down arrows as input mechanisms, because that forced users to look at the display rather than at the keypad, and because they could only make incremental adjustments. It is interesting that such a subtle difference – i.e. where the users will focus during the interaction – can make such a difference.

This section should have given you an idea as to why interaction design is so important, what consequences poor interactions can lead to, and conversely, what benefits good interactions can provide.

But what makes a design good or poor? What makes interactive products succeed or fail? In other words, what is interaction design all about?

The following activity is designed to help you think about these questions.

Activity 4 Experiencing and designing for different capabilities
1 hour

This activity is about exploring and experiencing what it is like to operate everyday devices when the user has quite different capabilities. It is important that you carry out all aspects of this activity, as you need to be able to refer back to your experiences while studying this section.

a.   Select an everyday device that you might use on a regular basis and carry out a straightforward operation that you normally do. For example, try composing a short text message with your mobile phone, making a phone call with your home phone, or operating your TV using a remote control.

b.   Now, try doing the same while wearing thick gloves; if you don't have these, try putting your hands into very thick socks. This is to simulate constraint: for example, you might be on a ski slope wearing heavy gloves, or you might have no fingers, or you might have very large fingers with little dexterity.

c.   Make a note of the difficulties that you experience (if any) and why you think you are experiencing them. Now think about what you need to do in order to fulfil the action you're attempting. What properties would the device need to have in order for you to carry out the action, given the constraints of the glove or sock?

d.   Now think about how you might alter the controls in order to meet your needs. Can you think of more than one alternative?

e.   Now, using pen and paper, try drawing one of the alternative versions of the controls that you have considered.

f.   Try 'interacting' or pretending to interact with your sketched device while wearing thick gloves or socks. Are any improvements needed? If so, think again about what you need and what changes you think are necessary to meet those needs, and then draw the controls again and try them out.

g.   Make a note of the changes you would make to the original device and why you think these would be necessary to enable you to use it.

Discussion

For this exercise, I tried using my old Motorola mobile phone while wearing my big oven gloves (Figure A).

Figure A Holding a mobile phone while wearing oven gloves

Of course, the flat keypad of this particular model of phone makes it impossible to press the keys with precision with the gloves on, so I had to think of a different keypad. To have something to compare my drawings to, I first drew the phone's keypad more or less to scale (Figure B).
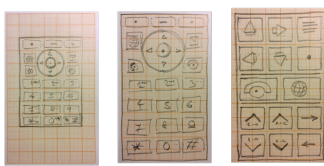
Figures B–D B Layout of controls of phone drawn on graph paper – normal size; C Layout of controls of phone drawn on graph paper – enlarged size; D Reorganised keypad layout

My first modification to accommodate the fact that I was wearing mittens was a reproduction of the same keypad in a larger scale (Figure C): this worked a lot better with my gloves, but it meant that I would have to go around with a huge phone, which I was not happy about.

To reduce the size of the keypad and still be able to use it, I had to reduce the number of keys, so I had to rethink the way in which the keypad was organised (Figure D).

In my reorganised keypad, each function only has one key (e.g. there is only one 'enter' key instead of two and users have to select options to enter via the arrows at the top of the keypad) and some keys can be used for multiple choices (e.g. 'up and down' keys can be used to choose different letters and numbers … I copied the idea from the infusion pump interface, described by Professor Harold Thimbleby in Activity 4). This arrangement and reduced number of keys means that I need to press the same key multiple times (e.g. when I want to bring up a particular letter) or for different durations (e.g. the 'left' and 'right' arrows at the bottom of the keypad could be used to move the cursor left or right if pressed quickly, or to delete letters and numbers if pressed for longer). This is less convenient, but it means that I can still have a phone of a reasonable size and that I can use it while wearing the mittens.

1.4 Interaction design activities

As the previous activity shows, in order for an interactive product to do a good job it must be designed with the user in mind. Indeed, *user-centred design* is a core approach of interaction design, meaning that every good interactive product is designed around the users, their environment and their activities, so that it is fit for purpose.

In order to support user-centred design, the interaction design process includes some fundamental activities. To help you recognise what these are, think again about what you did in Activity 4:

1. You tried to use a device like your phone or remote control with heavy gloves or thick socks on your hands, which gave you an idea of how users with certain physical characteristics and in certain contexts might struggle, what their needs might be, and what changes you might have to make to meet those needs.
2. You then came up with alternative design ideas.
3. You drew up the alternative designs.
4. You tried 'interacting' with the drawings while wearing your gloves or socks, to see which might work better if it were to be developed into a product.

In other words, you conducted the four fundamental activities that make up the interaction design process – establishing requirements, designing alternatives, prototyping designs, and evaluating prototypes.

1. **Establishing requirements** – a requirement is a need that a particular interactive product must be able to satisfy. Establishing what is required of the product is essential to ensure that the interaction is the best possible fit for the user, both in terms of what the user needs to do with the product and how they experience the interaction. Requirements will depend on the characteristics of the user, the activities the user will perform using the product, and the environment in which the user interacts with the product. In the example of a phone or remote control, requirements are shaped by the need to use the device (e.g. mobile phone) to do certain activities (to make phone calls), given the size and mobility of the user's hands (bigger than standard or fingerless) and the user's physical environment (ski slope).

2. **Designing alternatives** – coming up with alternative designs enables designers to explore different ways of interpreting and satisfying the requirements for a particular interactive product. This is an essential and highly creative part of the process. In the phone and remote control example, this activity began when you started jotting down alternatives for the controls. Design ideas should be informed by fundamental design principles that derive from what we know about how our minds and bodies work.

3. **Prototyping designs** – once interaction designers have identified a number of possible ideas, they need to figure out which ones have the potential to work best for the users, their activities and their environment. To do this, designers need to *prototype* the most promising design ideas to make a first, often rough, model so that they can try them out. In the example of the phone or remote control, as you thought of different designs, you were also prototyping them by drawing the alternative interfaces you thought of. Prototyping can also be used to explore different aspects of a design.

4. **Evaluating prototypes** – evaluation enables designers to assess the limitations of a particular design, to find out to what extent a prototype meets requirements that have already been identified, to identify requirements that have not already emerged, and to establish what changes need to be made so that requirements are met.

In your interaction design exercise, you performed a rough evaluation of your paper-based prototypes of a phone or remote interface by trying to 'interact' with your designs while wearing the gloves or socks. Therefore, while this was a task that was relatively easy to execute, it had all the elements of what we consider to be the fundamental activities in interaction design. In this course you will be introduced to different ways of achieving better designs that are informed by the needs of users.

1.5 Smart Glass – an example of designing

Interaction design activities don't necessarily take place linearly, one after the other. More often than not, they take place in parallel, particularly in the case of large, complex projects. Each activity may be repeated several times. These different activities may also take place in a different order.

Whatever the order of activities, there are several characteristics to the process of designing that are fundamental to creating usable interactive products that provide a satisfying user experience. To clarify these points, imagine that you are a designer who is working on a new interactive product along the following lines:

> You want a way to help people avoid drinking too much alcohol. What if a glass could keep track of your consumption (or at least of how many times it is filled and emptied) (*establishing requirements*)? You imagine a small device that you can stick to and unstick from your wine glass that alerts the user with a beeping sound when they have had enough to drink. You decide to call it a Smart Glass (*designing*). You might start prototyping your Smart Glass (Figure 12), perhaps sticking a small strip to a glass that contains a tiny microphone that you can activate to simulate an automatic alert (*prototyping*). You ask a few friends to try using your prototype (*evaluating*).
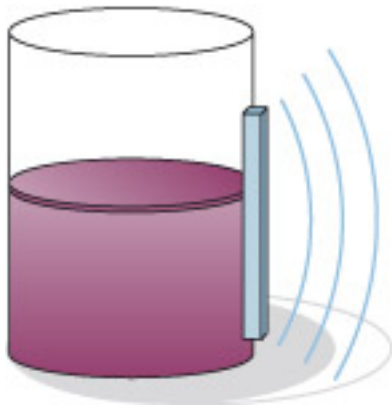
Figure 12 Representation of the Smart Glass. The long, thin object stuck to the side of the glass represents the small device that monitors the user's alcohol intake and alerts them when they have reached a safe limit

Based on your friends' experience and feedback, you realise that you need to better consider how the device affects the user's grip on the glass, particularly if their hands are wet or their dexterity is limited (*requirements*). You might then modify the shape of the device (*design alternative and prototyping*) and give it to your friends again, specifically to evaluate the grip (*evaluating*).

You might find that this has improved, but that now something else comes up that you had not previously considered: many of your friends like to drink in the company of others, but at the same time they do not like others to know how much they have had to drink, so the glass would need to alert the user more discreetly while still getting the user's attention among various distractions (*requirements*). You might then choose to use a gentle, intermittent vibration that only the user can perceive, instead of a beeping sound (*design alternative*).

In other words, having started with a prototype you have gradually uncovered requirements through the evaluation of the prototype.

The Smart Glass example not only illustrates the four interaction design activities and their interrelationships, but it also highlights some key characteristics of interaction design. These are:

1. **Iteration** – certain aspects of the design context (e.g. that people may not like others to know how much they drink) or limitations of particular design solutions (e.g. the strip interfering with grip), may only become apparent when a prototype is evaluated. Not all requirements and limitations emerge at the same time; they may emerge gradually over the course of several evaluations, each of which might focus on different aspects of a design, depending on the complexity of a product. Therefore, iteration is a key feature of the interaction design process, leading to an increasingly better understanding of a product's requirements and to incremental improvements in how those requirements are met.

2. **Usability and user experience** – the Smart Glass example illustrates the importance of considering both what might make a product *usable* (e.g. making it easy to grip the glass) and what users might *experience* while using a product (e.g. embarrassment if an alert publicises their consumption). It's important that a thing works well, but also that people have a satisfying experience using it. Ideally, interaction designers should identify specific requirements for usability and user experience at the beginning of a project, so they can work systematically towards achieving those requirements and measure their progress against them. This is

especially important where there is more than one person working on the project, and so there is a need to ensure that everyone shares the same priorities. In reality, some usability and experience requirements may only be identified during the interaction design process, as less obvious aspects of the users, their activities and their environment become clearer.

3. **User involvement** – finally, the Smart Glass example also shows the importance of involving prospective users throughout the design process. User involvement is critical in helping designers understand the design context (e.g. that users might like to drink in company, but not want others to pay attention to how much they drink), and identify possible design solutions (e.g. using vibrations instead of sound for alerts). Some approaches to the interaction design process are highly *participatory,* inviting prospective users to take a very proactive role, for example, by proposing design ideas instead of just providing feedback on prototypes developed by the designers.

Section 1 Summary

Section 1 has offered a broad introduction to interaction design. In particular it has illustrated that:

- As technology has developed, the nature of users' interaction with technology has changed, and the scope of interaction design has broadened. Interaction is now multisensory, embedded in everyday objects, mobile – and interactive products can be connected and dynamic.
- Interaction design is important because good design has benefits, and bad design has consequences and costs that can be extreme.
- Interaction design is about creating interfaces that are fit for purpose in terms of users, environment and activities.
- Interaction design comprises four interrelated and iterative activities: establishing requirements, designing alternatives, prototyping designs and evaluating prototypes.
- The interaction design process must be user-centred. User-centred design displays three key characteristics: it is iterative; both usability and user experience are considered; and prospective users are involved throughout design.

2 Goals and principles of user-centred design

In Section 1, we discussed key aspects of the interaction design process, including the importance of establishing clear usability and user experience goals. In this section we go into more detail about what we actually mean by usability goals and user experience goals, and how we can assess whether a product can be considered to have achieved these goals. We also introduce design principles that can help to aid a designer's thinking when they are designing interactive products.

2.1 The goals of interaction design

Generally speaking, any interactive product should provide good usability. But what do we mean when we say it is 'usable'? Over the years interaction designers have identified a number of specific qualities, which are aimed at during the design process and referred to as 'usability goals. Typically, these are:

- **Effectiveness**: does the product enable the user to easily accomplish the task for which it is designed?
- **Efficiency**: does the product enable the user to accomplish a task quickly with a minimum number of steps?
- **Safety**: does the product minimise opportunities for users to make errors and, if they do make errors, can they recover easily?
- **Utility**: does the product offer the functionalities that users need to complete a particular task?
- **Learnability**: is it easy to learn how to use the product?
- **Memorability**: is it easy to remember how to use the product?

The above usability goals are all quite different, emphasizing different aspects that we aim for in a design. Here we want to highlight a number of key points about usability goals in general:

1. **Measurable goals.** Compared to the general concept of usability, usability goals are more specific – and can be assessed and measured, thus helping you to work towards good usability in specific cases. So when thinking of assessing or aiming to improve the usability of the products you design, your focus should always be on these more specific goals. In the example of the Smart Glass discussed in Section 1, designers could set a safety goal that users must be able to hold the glass securely without dropping it. To see if the goal is met, they could measure how many times (if any) the glass slips from the users' hands during a given period of time.

2. **Goals must be prioritised.** While all usability goals are relevant to all interactive products, it is not always possible, nor desirable, to achieve all of them in equal measure. For certain products, some of the goals are more important than others and will need to be prioritised.

Think, for example, of the interface of an ATM (automated teller machine – Figure 13(a)); anyone, regardless of whether they have technical skills or whether they have used ATMs before, needs to be able to engage successfully with the interface straight away. Therefore, the most important goal for an ATM is that it needs to be very quick and easy to learn to use.

On the other hand, flying a plane (Figure 13(b)) is a much more complex task and, consequently, the plane's control panel is correspondingly complex; planes are also only flown by highly-specialised users who have received considerable training and fly planes regularly. In this case, learnability and memorability are not the most important requirements: instead it is more important that the control panel allows the pilot to carry out complex tasks efficiently and, above all, safely. Indeed, when it comes to safety-critical tasks, such as flying planes, safety has to be prioritised over efficiency, although the two are linked and efficiency can help improve safety.

(a) (b)

Figure 13 (a) People queuing at a cash machine; (b) pilots in the cockpit of a plane

1. **Meeting goals may be challenging**. The characteristics of users, their activities and the context in which they operate can make it challenging to achieve certain usability goals, while making it particularly important to achieve those very goals.

    For example, in Section 1 Activity 3 we saw how, in the case of one blood infusion pump, the pressure under which nurses work and the environmental distractions to which they are exposed made it very easy for one of them to make a fatal error (Figure 14). Instead of making the pump extra safe to use under those conditions, tragically the pump's interface had allowed the nurse to set the pump to deliver an overdose and had failed to alert her to the error. Cases like these demonstrate how certain usability goals may be very important; designers must recognise their importance and make an extra effort to ensure that these goals are prioritised and met.

Figure 14 Blood infusion pumps stacked on top of each other.

But great interactive products do not just provide good *usability*, they also provide good *user experience* – that is, they not only enable their users to do what they want to do, but they do so in a way that feels good and enriches their users' lives in one way or another. Desirable qualities related to user experience, which interaction designers might aim to provide for prospective users, include *motivating, exciting or enjoyable*; while undesirable qualities that interaction designers might aim to avoid include *boring, frustrating or unpleasant*. Bear in mind that the list could be as long as the list of positive or negative adjectives that might describe one's range of emotions.

Indeed, there is a key difference between usability goals and user experience goals. On one hand, the extent to which usability aims have been achieved is relatively easy to assess by measuring aspects of a user's performance while interacting with a product or prototype. Examples include whether a past user can remember the sequence of steps required to extract cash from an ATM; how quickly a pilot can perform the task of redirecting a plane; or how many errors a nurse makes when setting a blood infusion pump, whether they notice the errors and how easily they can recover. This makes usability criteria relatively objective and therefore easier to design for.

On the other hand, the extent to which user experience goals have been achieved is more difficult to assess objectively, precisely because it has to do with the users' feelings rather than with their performance. Therefore, interaction designers tend to assess the users' experience via subjective measures – for example, by asking the nurse whether they felt uncertain or frustrated when trying to set the blood infusion pump. This makes user experience criteria relatively more challenging to design for.

However, it is important to remember that, whether we talk about usability or user experience criteria, ultimately everything about an interaction with a product contributes to the experience of the user. A product with poor usability cannot provide a good experience. Equally, a product that does not provide a good user experience may as a result be less usable.

2.2 Design principles

As we mentioned in Section 2.1, in order to achieve usability and user experience goals, design choices need to be guided by certain principles. These design principles derive from the way our minds and bodies work.

Design principles can also be seen as building on each other, so we first introduce *perceivability*, because we first experience an interaction through our senses, which is a starting point for any interaction. However, in order for us to be able to make sense of an interaction, the things that we perceive need to be *consistent*, so we can interpret them and make predictions of what might come next. Next we talk about *affordance*, which can be seen as a particular kind of consistency between our potential for interaction and the interaction afforded by a product, while *constraint* is effectively a kind of (negative) affordance telling us where we can (not) interact. Finally, *feedback* tells us when we have interacted and thus signals the end of the interaction.

The following will further clarify the importance of each of the design principles.

Perceivability

Figure 15 The devices pictured were developed at the Mixed Reality Lab based at City University London. Each uses a different sense to communicate remotely: the device on the top left is a ring that vibrates when the receiver is being kissed by the sender; the device on the right can be connected to a smartphone to receive scent messages from a sender; the device on the bottom left enables the user to receive messages through taste.

The principle of perceivability acknowledges that our experience of any interactive product passes through our senses first. The more prominently an element of an interface engages the user's senses, the easier it is for the user to perceive that element, which is a prerequisite to understanding what that element does and how to interact with it. For

example, the louder the voice of a satnav, the stronger the vibration of a mobile phone or the bigger an icon on a screen, the easier it is for the user to perceive those stimuli.

The extent to which the elements of an interface are perceivable depends on the characteristics of a product's interface, the characteristics of the user and those of the environment in which the interaction takes place.

Consistency

Another fundamental principle – that things with the same function appear and behave in the same way – underpins the way in which we make sense of the world, including the products with which we interact. Consistency allows us to identify patterns and give them meaning, which in turn enables us to make sense of our experiences, to predict what might come next and to decide what choices to make in order to pursue our goals.

The same goes for interactive products: if the menu items on a website were organised differently on every page, the website would be rather difficult to use, as the user would have to search afresh on every page they visited. On the other hand, if a menu item linked to a different page each time the user followed it, the website would be impossible to use, as the user would have no way of knowing where they might end up every time they followed a link. Therefore, it is not enough for the elements of an interface to be perceivable: they need to be designed and organised with consistency, and interacting with them needs to yield consistent outcomes.

Affordance

This is the way in which the perceivable characteristics of an object, such as shape, size, location, colour or texture, signal the way in which the object can be used. This applies to both physical and, by similarity, virtual objects. For example, a physical button affords to be pushed down; similarly, the virtual representation of a button on a website evokes the affordance possessed by the physical object it represents, thus letting the user know that they can press it (i.e. click on it).

It is important to consider that the extent to which the characteristics of an object communicate certain affordances depends on who the user is. For example, the iconic representation of functions is only useful if the user has the ability to recognise virtual objects as referring to physical ones familiar to them – for example, a virtual button will afford pushing (through clicking on it) only if the user recognises the icon of the button in the first place. This is a particularly important consideration, for example, when designing interfaces for very young children or for people from very different cultures. Indeed, affordance can be described as a special form of consistency between the characteristics of an interface and the characteristics of its user.

Constraints

This is when the interactive options and functions of an interactive product are temporarily restricted. Such restrictions may be imposed to prevent users from making mistakes or from following dead end paths when completing tasks that require multiple steps. For example, on certain pages, the menu items of a website may be temporarily disabled and, to spare the user unnecessary frustration, those items may be greyed out to signal that they are disabled.

Box 2 From Leonardo's painting observations to interaction design principles

Greying out disabled controls as a form of constraint while allowing active controls to stand out creates a mapping between the status of controls and their perceivability. This is a well-established convention in interface design, and the reason why it is so well established is that it is consistent with the way in which our visual perception works in the real world.

Figure 16 Leonardo da Vinci, Madonna of the Yarnwinder, c. 1501. Oil on canvas. New York: Private collection.

Leonardo da Vinci was the first to highlight, when discussing the art of painting landscapes, that the further away objects are, the blue-greyer and lighter they appear. This is a physical phenomenon due to the way in which light is filtered through and reflected within the atmosphere, such that the greater the distance between our eyes and an object, the greater the 'discolouring' effect. Of course, the implication is that if 'discoloured' objects are far away, they are also out of reach. Therefore, greying out controls to signal that they are there but temporarily 'out of reach' is not just an arbitrary convention, but rather one that is

implicitly grounded in our experience of the physical world, and that is probably why it is so well established.

Feedback

Responding promptly to user input by returning information about what action is underway or completed is a fundamental principle specifically relevant to interaction design. In interactive products, feedback is of critical importance, as it lets the user know that they have engaged with the system successfully, whether by inputting information, initiating an action or process, or completing a task. For example, video applications such as YouTube have a function enabling users to change the volume of a video: as they click and slide along a bar located at the bottom of the video's window, the bar changes appearance, visualising what the user is doing; meanwhile the volume of the video increases or decreases accordingly. Thus the user receives two types of response (output) – the bar visualisation is the feedback, while the sound variation is the actual outcome of the interaction.

In some cases, the outcome of the interaction is not directly perceivable; in these cases it is even more important that the user receives feedback. For example, if a user transfers money through their online banking service, once the transfer goes through, they should receive confirmation from the system that they have successfully completed that task; the outcome of this interaction is of course the actual money transfer, but the only way for the user to know that the money has actually transferred is via the feedback provided by the service. The main difference between feedback and outcome is that feedback is just an acknowledgement of an interaction, whereas the outcome is the effect of that interaction resulting in a change in the system's status or in the real world. However, feedback is critical as it enables the user to assess the outcome of their interaction and what steps they need to make next in order to complete a task.

Section 2 summary

In Section 2, we have introduced the general goals and principles that apply to the design of any interactive product. In particular:

- We have discussed more objective usability goals, such as effectiveness, efficiency, safety, utility, learnability and memorability; as well as more subjective user experience goals.

- We have introduced design principles, such as perceivability, consistency, affordance, constraints and feedback. We have made a connection between these principles and other aspects of our interaction with the world, as in, for example, the relation between Leonardo's observations on landscape painting and the greying out of menu items. Such connections help us understand where design principles come from, how they are relevant to our interaction with things around us, and why they are so important in interaction design.

- We have seen how both interaction design goals and principles need to be taken into account for good interaction design.

3 The 'who, where and what' of the design context

Section 2 discussed the importance, when designing an interactive product, of usability and user experience goals. At the same time, the discussion of design principles emphasised that their implementation needs to consider the user carefully. Section 3 focuses on more specific aspects that characterise the user, and also considers the nature of the activity in which the users are engaging and the environment in which the interaction takes place.

You will study the design context through reading conversations with two different users and will be sharing insights based on your conversation with a person of your own choice.

3.1 Designing for different users

In Activity 4 of Section 1, you saw how physical constraints can drastically impair the user experience and reduce the usability of devices such as mobile phones or remote controls; and also that there are many other ways in which an interactive product can let the user down. For example, a website interface that relies heavily on colour may be great for those with good colour vision, but present poor perceivability, and consequently provide poor user experience or even poor usability, for those who see a different spectrum (Figure 17).

Figure 17 Honey Bee Match 3 is a computer game in which the player has to swap objects in order to match them by colour. Bottom right shows how the game appears to those with good colour vision; top left shows the game as it appears to those who see a different spectrum, losing all the information they need to play the game

Here we discuss a way of thinking about users in order to understand their characteristics. We also consider what activity the users are engaging in and where the interaction takes place.

Here we reflect on this through accounts of two different users talking about their experiences of using an application on their mobile phone to keep track of their running.

Case Study 3.1 Two Users on their use of a running app

Jane

Jane is 55 years old and has recently taken up running to improve her fitness levels. She is in relatively good health, but being sporty and active is a new thing for her. She has good eyesight – although she uses reading glasses – good hearing and no other obvious health issues. She tries to go out several times a week and, to set herself a challenge, she has recently started training for a 10 km run. Her daughter is also training for this event and has recommended that Jane uses an application on her smartphone, both to keep track of her progress and so that she can make use of audio tracks to motivate her and set a pace.

Q: What do you use the app for?

A: Well, I use it for each run, and try to keep track of the distances I'm doing and how fast I am. I want to monitor whether I am getting closer to the 10 km target, to see whether it's realistic to take part in the race. I can see that my pace differs a lot from run to run, but I don't think I need to worry about that. Sometimes I am running on a road, with a very even surface, and sometimes I run through muddy fields, which is of course slower.

Q: Do you use any of the audio facilities?

A: There's a feature in the app that has an imaginary trainer to give you feedback on how you're doing, like, 'Three kilometres – you are halfway through today's target. Keep going!' or something like that. I thought I would like that, because then I'd know where I am with my run, and I wouldn't have to interrupt my run to try to read a screen without my glasses. But actually I found it distracting and I don't use it.

Q: Do you use the audio facility for music to go with your run?

A: No, I find that very annoying, too. I don't want to wear earphones and I don't want music in my head. I prefer to be with my own thoughts. I also enjoy seeing the things around me. Like seeing a few horses in a field or some flowers that are opening up or whatever. But all that music doesn't fit with running – for me it's about being outside, in nature.

Q: How do you like the menu structure on the app? Does it have the main features you want in the right place?

A: Well, that's crazy. It used to be very easy but then I did an update or something, I don't know, and the interface changed. I now find it very difficult to actually stop the app. When I get to the end of my run, I want to be able to quickly hit the 'stop run' button – but I have to go through a number of screens before I can do that. A login screen, asking me for my password, and a few other screens … And, of course, I can't see what all the messages are to get me to the right screen because I haven't got my reading glasses with me when I'm running! I am also a bit clumsy at the end of my run

anyway, because I am sweaty and a bit uncoordinated, so my fingers don't seem to know how to do all that swiping the screen and entering passwords. So it takes me ages. I just wish there was one big, really clear button to hit at that point. All this fussing with the app to get it to stop really winds me up, because it is adding extra seconds – minutes even – to the run just when I'm interested to know what my time was!

Q: Oh dear. That's a problem. And do you use the online facility for sharing results?

A: No, I just keep it on my phone. I might talk about it with my daughter or some other people, particularly if it's been a very good run, but I just keep it for myself. I don't want all this sharing stuff on Facebook or whatever. It's none of their business.

(a)   (b)

Figure 18 (a) Jane enjoys running through woods and fields; (b) Craig enjoys running with his friends and family

Craig

Craig is 48 years old and is a keen technology user who enjoys keeping track of all issues related to health and fitness. He uses different technologies to track his levels of activity, including a Fitbit device which counts his steps, a tracker that is built into his phone, an app on his phone that keeps track of location and that recognises whether he is cycling, running or walking, and another app on his phone that is specifically for running. He is in good health, with good hearing and eyesight, and he enjoys running with his family and also with friends and colleagues.

Q: About the running app on your phone, how do you use it? What is it for?

A: I like to be able to compare my runs to previous runs – like my distance or average speed. And I also like to compare my runs with other people's. For example, how I compare with other people in my age group.

Q: Do you use any of the audio facilities?

A: Yes, I use the one through the phone's speaker, it gives me an update on each kilometre I complete, and it also gives me an audio summary at the end to say how today's run was and how it compares to the previous one. I find that a useful facility.

Q: And music? Do you listen to audio tracks while you are running?

A: Well, I know a lot of people do that to help pace themselves. I used to do it, and it would change if it noticed your pace was increasing and then the music would change and become more upbeat – but now I don't do that. You would need to wear earphones to listen to music and for me running has become a social activity, so I don't want earphones. I want to be able to talk to people while I'm running. Running has become a social thing, more than anything else. So sometimes while I'm talking I can still hear the audio update about how far I got, or my average speed or something, and I may not hear it properly because I'm also talking. But that's OK – it still registers somehow.

Q: How do you like the features on the menu, can you find things?

A: Well, beyond starting and stopping, which are the obvious things you need when you're running, things can be fairly complicated. I do sometimes use more advanced

features, but by and large for me the main thing is being able to stop and start. Although pausing can be useful as well. Sometimes you want to interrupt your run, perhaps you're stopping to talk to someone, and you don't want this to get added to your time, so you pause. But then sometimes I'd found that I got confused with the controls and had mixed up pausing with stopping or something. Or I think the screen doesn't react to your touch in the same ways as it normally does because you're running. You know, the conductive touch screen doesn't register things properly because you're sweaty or you're cold.

Q: What about sharing data about your runs? Do you share them online?

A: Yes, I do a lot of sharing. Obviously with my family – we use it as a way to encourage each other. And I get messages from colleagues with whom I'm sharing, saying, 'Anna has just finished a 5 km run' or something, and she may be at the other side of the country. I like that feature. But there are also some stretches of my run, in my neighbourhood, where it shows me how other people have done on that particular stretch. I like seeing who else is running – not because I'm competitive, but I do like to compare myself.

These two accounts from people using a running app on their phone show both similarities and differences between users. The users share an interest in recording their data and comparing their runs, are of a similar age, and don't want to use earphones when running, but have different motivations for this choice. What else do we know about the users and what can we pull out of these conversations with runners to help us reflect on design that keeps in mind the users, the activity and the environment for the interaction?

Design context: the users

One way of thinking about users is in terms of their innate capabilities.

1. **Physical capabilities**: do the users require certain levels of dexterity in their hands or limbs to operate the product, or do they require force to make it work? Are there any other physical capabilities that we should keep in mind?

2. **Sensory capabilities**: how well can the users perceive input to their senses? Are the users likely to have good vision? Are they likely to require the use of glasses? Is their hearing OK and is the sense of hearing an important part of being able to interact with the product? What about the other senses – such as touch? Or smell?

3. **Cognitive capabilities**: are the users able to process the level of information required by the device? How can they use information gained through their senses to help them make decisions? Will it take them long to learn something? How are they likely to respond emotionally?

In the example of Jane and Craig, we note that both have relatively good vision and hearing, but that Jane requires reading glasses in order to interpret finer print on small displays. Their hearing seems good enough to be able to hear audio feedback on their running results, but both reject the use of earphones for different reasons. Neither of the runners seems to struggle with processing the data about their runs, as there is no mention of trouble in interpreting the calculations and stats about their timings and speed. However, both do appear to struggle, from time to time, to use the controls on the interface, either through not seeing information properly or from their fingers slipping on the touchscreen.

But there is more to users than their innate capabilities: their *background* and *experience* also shape their engagement with the world. They may have special skills or knowledge that are relevant to the activity – or they may have none, so they may need additional support. As a result of their background and experience, as well as their capabilities, they may have developed *preferences* that colour their user experience, making them more accepting of an interface that fits, for example, with their aesthetic or functional preferences but less accepting of one that does not. Their experience with particular activities or technology may give them a useful familiarity or special insight, perhaps making it easier to adopt certain features of an interactive product.

In our examples, Craig has more experience in using technology for sports and uses several devices, whereas Jane is less experienced and sport is described as a new thing for her. Craig sometimes uses advanced features on the app. Both find the interaction to be problematic during a run; they both want simpler 'start' and 'stop' controls. Both prefer to run without earphones, but Craig still likes the audio feedback about his activity and manages to process both conversation with other runners and audio updates, whereas Jane finds audio distracting and prefers to focus on her environment. Both have competing preferences (wanting feedback but no earphones); it is often the case that users' desires and needs are in conflict, so that the designer must make trade-offs. Both Jane and Craig want to know how they're doing in comparison to others, but, whereas Craig is happy to share his data, Jane has a stronger sense of privacy. The users' characteristics affect both the usability of the app and their experience of it.

Design context: the nature of the activity

The example of the running app reveals that the capabilities of users should not be seen in isolation but should be understood within the wider design context. In particular, the capabilities should be viewed in the context of the actual *activity* carried out during this interaction. For example, vision is not a big problem for Jane, who only seems to require reading glasses – something which is very common for people of her age. However, she doesn't wear her reading glasses while she is running, which means that her vision is limited during the activity. This affects both usability and her user experience.

Furthermore, neither user appears to have problems interacting with mobile devices in general. However, they both confess that during or after running they can struggle to interact with the controls. At these moments they can be sweaty, thirsty, out of breath, etc., and selecting the right controls under these circumstances can be more challenging than usual. This seems to affect both their vision and their dexterity – Jane mentioned that she feels clumsy having to use the touchscreen, and Craig mentioned erratic interaction with the conductive touch screen due to sweatiness or cold fingers. Again, these are effects of the activity.

The activity also has a social setting, and runners may approach the activity of running in quite different ways. Jane appears to run mostly on her own and for her it is a more private activity, during which she prefers to be aware of nature; whereas Craig likes to run with other people and running is a highly social activity, during which he wants to be able to chat. For both it is their particular 'take' on the activity that influences whether or not they want to use music tracks through headphones. Craig mentions that there is some interference between the audio feedback coming from the app and his ability to chat with fellow runners. Jane doesn't want to share her data, but Craig does – being able to compare his performance to others' is part of the value of the app. This highlights the

importance of the wider social setting of the activity, and also how user characteristics such as preferences contribute to the interpretation of the activity.

Design context: the environment

The physical environment in which the user interacts with a product may have a significant effect, not only because the product itself may be affected, but because the user's ability to interact with the product may be altered.

For example, is it cold and rainy when people are jogging? Would the cold stiffen their hands or the rain wet their phone and prevent them from using the touchscreen? Are they running in the dark in poorly lit areas, and would the low visibility affect their ability to use the interactive product? Are they running in a place where they feel insecure, so that they don't want to display their phone? Is the environment too noisy for audio input or feedback? Are they running in a remote area where the signal is poor and the app can only use data that is stored on the phone?

Design context: The wider sociocultural, organisational and economic settings

The design context is more than the physical environment and can also be the wider organisational setting in which the product will be used, and also includes who is actually involved in the design process.

Although some interactive products may be designed in relative isolation, as the brainchild of an independent designer working outside any organisation or community, many are designed collaboratively within commercial organisations large or small. Sometimes design involves more than one organisation – for example, a consultancy company working with a client organisation or different subsidiaries of an international company. Just as individuals vary, organisations vary, and consequently the design process may vary.

Sociocultural: companies have different ways of working that may shape the design process. For example, companies offer varying degrees of flexibility to designers, some allowing individual teams to work as the equivalent of independent start-ups, others keeping interaction designers to strict roles within a larger structure. Some specify which tools should be used, others leave such choices to individual teams. Some divide development between different teams so that, for example, interaction design may be separated in time and scope from software engineering, or marketing may play a significant role in specifying products. Teams may come from very different perspectives; not just technical perspectives but also sociocultural ones. For example, many companies have development teams in different countries. At project level, sociocultural factors may influence ways of working (e.g. particular design, prototyping or evaluation methods; particular tools; particular team configurations), or constrain resources or determine the approvals processes.

Organisational: at the organisational level, a given interactive product may be conceived as part of a product line or portfolio, and therefore design choices may be influenced not just by the single product specification, but also by the styles, standards and technical infrastructure determined for the product line or portfolio. For example, a new interactive product may need to be compatible with other products, or may be constrained because some functionality is reserved for other products, or may be expected to make use of and interact with other products. There may be a company product strategy that either

demands features of any new product, or specifies some design choices. Decisions about which products to develop may hinge on the proposed product's fit with a company product strategy.

Economic: the size and wealth of a company may in turn affect the resources available for a given project – or the obligations of the project team. Resources may be evident in terms of the funding for the project, or in terms of the expertise that is readily available, or the tools and infrastructure that are readily available. More subtly, what drives the company may influence design priorities. For example, a charity developing an application to help disabled users access public services may have different priorities from a retail company developing a web-based shopping application. Moreover, external economic forces (such as the state of a national economy, particular government initiatives for development, or legislation that regulates industries and products) may influence interaction design at all levels, from funding to detailed design decisions.

Again, these categories are indicative of considerations that may arise as part of the wider production setting. We won't be dealing with these in detail in this course, but they are a normal part of professional interaction design.

As we have seen, there are many aspects that are important to consider when designing interactive products, including people's capabilities, their background, experiences and preferences, the activities they want to do, as well as their environment and social settings. Figure 19 summarises the aspects that you could consider, and the kind of questions that you ought to ask when you think about whom and what you design your interactive product for.
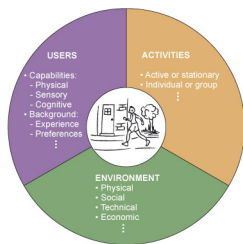

Figure 19 Aspects to consider when thinking about the who, the what, and the where of the design context

Activity 5 Thinking about the design context
60-90 minutes

In this section we have heard from two users about their use of a mobile technology to support their running. They provided insights into how to explore users' characteristics and about the interplay between these, the activity in which they engage, and the wider environment for the activity and hence for the interaction.

Find a person who is willing to talk to you about a leisure activity; for example, a sport, or a game or any activity that is not directly related to work but rather with something they do for pleasure or their personal benefit.

Engage them in a brief conversation about their activity. Try to find out something about their capabilities (physical, sensory or cognitive), other background factors that are relevant, and the wider setting for the activity. Do they use technology? If so, what are they using the technology for? If not, have they considered whether technology might play a role?

Write this up as a short paragraph, and also write a short paragraph with your reflections on the issues involving this user, their activities and environment.

Discussion

I decided to talk to the son of one of my friends who has recently started running and who also recently got a new smartphone. I was interested to know which facilities he'd be using when running – if using them at all.

Peter is 17 years old and goes out for a run once a week with his friend Jo. He has done a bit of running before, but he has got into a more regular routine with his friend. He has tried using audio tracks for running but didn't get on with this at all. He tried putting the phone on an armband, but this was hurting and got in the way of his arms moving during running. He thinks the armband was not the right size. He tried putting the phone in his trouser pocket but then it bangs against his leg the whole time during running. The wires from the earphones would also get tangled in his clothing and annoyed him when running. He now doesn't use any technology at all and sees running as an activity to be completely free from everything. He is not particularly fussed about timings of his run or seeing the distance he has covered – he likes to feel whether he is getting fitter or not. He does use earphones for other activities, such as when he is at his desk and doing some easy homework task, where it is nice and calming to have some music in your head.

Reflections on users, activities and environment

This user emphasises physical aspects of the running activity that are problematic if technology in the form of a smartphone is used. He has tried several methods of carrying a device while running, and also using audio through earphones, but these all get in the way when running. It sounds as if this has been such a frustrating user experience that he has put the technology to the side completely. There is also mention of using earphones when doing calmer activities – such as doing homework – in an indoor environment. So the preference for earphones is very much influenced by the specific activity and the type of environment he is in.

Section 3 summary

In this section we have seen how there are many aspects to consider when designing an interactive product due to the fact that:

- computing is increasingly integrated into daily activities and a greater variety of users are now engaging with interactive technology in novel ways, with different levels of awareness
- users engage through different senses and body parts, in different spaces and social configurations, within different environments and settings.

To help you deal with this complexity, the section has provided a framework for considering the users, their activities and their environment (summarised in Figure 19). Specifically, the section considered:

- the user's physical, sensory and cognitive capabilities
- the user's background, experience and their preferences

- the activity the user is engaged in when using the interactive product – or trying to accomplish by using it
- the environment in which the interaction takes place
- the interplay between user, activity and environment.

Beyond these, we considered the wider context, including potential stakeholders and the wider sociocultural, organisational and economic settings in which the product might be developed and deployed.

All these aspects are relevant when considering the *requirements* that the product will need to satisfy.

4 Interaction design activities and methods

As a result of the increasing variety and complexity of interactions, and in order to address the kind of questions discussed in Section 3, designers need to employ an ever-expanding range of methods throughout the interaction design process. In this short course, we briefly introduce these methods and, using a few examples, we show you how they are used in establishing requirements, producing alternative designs, prototyping some of the designs and evaluating the prototypes.

In the video below, Sarah Wiseman discusses the design of the telephone interface. The video traces the history of phone dials and keypads, and how in the 1950s researchers used a variety of methods to select the configuration of keypad numbers still used today.

Activity 6 Why are keypads the way they are?

1 hour

Watch 'Phone buttons' below and then answer the following questions:

Video content is not available in this format.

a. How did researchers test which keypad configuration was best and what did they pay attention to?

b. How did researchers determine how long a phone cord should be and why did they set out to do that?

c. What were the two aspects researchers were focusing on when testing for different number arrangements? Which of the usability goals we discussed in Section 2 would you say best describes those two aspects?

d. Besides usability goals, did they focus on any user experience goals for the layout? If so, which one(s)?

Discussion

a. In one experiment, they tried out different layouts and tested people on how fast they were on each layout, how many errors they made and also asked which one they preferred.

    In a different experiment, people were given pieces of paper with layouts of empty places and were asked to fill in where each number should go. This showed that 55% of people felt it was most natural to go 1 2 3 on the top horizontal line.

b. The researchers gradually cut shorter the cables of the phones of their colleagues until the colleagues started complaining. Then they knew they had found the minimum length. They needed to know this because copper is an expensive metal and was part of the cable.

c. Researchers were looking at how fast people could enter numbers in the different arrangements, and how many errors they were making. The first aspect corresponds to the usability goal of *efficiency*, which is about how quickly a user can complete a task; the second aspect corresponds to the goal of *safety*, which is about preventing users from making errors.

d. Yes, they also wanted to know which layouts people preferred. This can be described as a user experience goal focusing on qualities such as 'what is the most natural', or the 'most intuitive' layout.

4.1 Gathering data: input from the design context

We have now seen a few different methods by which UX companies and researchers collect data about user behaviour and user experiences in order to gain insights into interaction design. Each method highlights a particular aspect of the interaction design; so using them in combination yields a more complete, more accurate or richer picture. Here we offer a simple, general categorisation of methods.

Asking the users

A very common approach entails *asking* users to talk about their experiences, habits, opinions, preferences and so on. This can be done using methods such as questionnaires or interviews, where single individuals are asked to provide information based on questions from the designers, or focus groups, in which a group of people are gathered together to discuss issues around a specific topic or product.

These methods can be applied in a more or less structured way, depending on whether you are just beginning to explore the issues or you are investigating a particular aspect of the design. A questionnaire could be highly structured and include questions with multiple-choice answers, or it might be less structured with open-ended questions, allowing people to express their thoughts freely. Similarly, interviews might follow closely a sequence of specific questions, or they might be loosely guided by some general questions, allowing the interviewer to explore in more depth relevant topics raised by each person being interviewed. The same applies to focus groups, which can be strictly focused or leave room for a wider discussion.

The advantage of using methods that invite people to share their thoughts is that they elicit the user's own interpretation of things they know or have experienced. We call this a

subjective interpretation, as it concerns the user's personal account, very much from their own perspective. In other words, this is not a general interpretation that is known to hold for a group of people and which is corroborated – which would be referred to as an objective interpretation. However, there are limitations to asking people to describe their experience: people aren't always sure about how they feel or what they want; they may not be aware of or remember things they do; or they may even misrepresent what they do.

Observing the users

A different approach is based on observing users and other stakeholders in different situations. You could do this directly, for example, by watching people while they are performing activities in their usual work or home setting; or you could watch them perform activities in a laboratory; or you might automatically log their interactions with a prototype through the technology itself. Where you do the observation depends on the nature of the activity you wish to observe and what you want to know about it. Alternatively, you could observe them indirectly, for example, by asking them to keep a record of their activities or of every time they use your prototype.

Observational methods can be applied in a naturalistic or in a controlled way. A naturalistic setting would be one in which the activity normally takes place, for example, someone's home setting or their workplace. This might be useful if you want to understand what users and stakeholders do in their daily lives. On the other hand, a controlled setting, such as a specially set up laboratory or space, could help you observe very specific aspects of an interaction and help to eliminate things that might interfere with what you want to understand, for example, distractions that might slow the user down. A naturalistic task would be one that arises normally in the user's world and that allows the user flexibility in prioritising goals and deciding how to approach the task. This might help you understand what sorts of things users normally do and what challenges or needs they have. On the other hand, a controlled task would constrain the users' choices so that all users do essentially the same, well-defined activity; this allows more rigorous comparisons of behaviours.

Matching methods to questions

The above categorisation is not meant to be complete, but rather to draw your attention to how methods are characterised, and particularly to what they emphasise or focus on. Different methods provide different kinds of information and matching the designer's question to the method of enquiry is crucial. For example, questions about usability are usually addressed by observing behaviour. Questions about the user experience are usually addressed by asking the user, or by a combination of asking and observing, because we can't yet look into people's minds to see what they think!

Similarly, the way we record responses or observations may vary, depending on what we want to know. If we're interested in user experience, we might need to focus on users' accounts – or we might want to examine the relationship between what users report and how they behave. If we're interested in behaviour, we might be satisfied with measuring how long users take to perform a given task and counting how many errors they make (known as time and accuracy measures), or we might want an analysis of where errors occurred. Hence, the data we collect may be numeric or it may be descriptive. And we might use different forms of data to complement each other.

Table 1 summarises this simple categorisation, which can be interpreted as a set of choices to consider when trying to choose a method to answer a question, whether about

requirements, usability, or user experience, i.e. whichever interaction design activity is being performed. It may be that you are aware of other ways of characterising methods that are particularly relevant or striking in your work. This discussion gives you a flavour of things to consider and particularly how it is important to pick an approach that will answer the question you have.

Table 1 A simple, general categorisation of methods

Ask	Observe
Individual or group	Individual or group
More or less structured	Naturalistic or controlled
Face-to-face or by correspondence	Direct or indirect
Numeric or descriptive data	Numeric or descriptive data

Activity 7 Categorising methods

30 minutes

Think back to Video 1.2 about the history of the telephone keypad.

a. Various methods were used to work out which keypad layout was the preferred one. How would you categorise those methods? Did they ask users or observe them? If they asked, was it more or less structured? If they used observation, was it direct or indirect? Was it in a controlled or a naturalistic setting? Why would they have selected that method?

b. A specific method was used to work out the minimum length for a telephone cord. How would you describe the method that was used?

Discussion

a. When the researchers were beginning to think about this issue and got participants to fill in blank layouts, they were trying to gauge preference, but they were doing so by directly observing people's spontaneous behaviour (how they arranged the numbers – similar to the case of Bunnyfoot's acetates). They used repetition of blank layouts, which allowed them to carry out quite a structured test conducted in the controlled setting of a laboratory. Five years later, when the researchers started to build the new phones, they got participants to actually dial numbers using phones with different layouts; directly observing behaviour to assess performance (rather than just preference); for comparison, it is likely that people's performance was recorded (e.g. by logging the dialled numbers) and that the tests were quite structured. This test was also conducted in the controlled settings of a laboratory. At the same time, the researchers simply asked participants which of the layouts was their favourite; presumably the participants were asked directly and not necessarily in a structured way, and it is likely that the setting was still that of a laboratory.

b. This study was conducted in a naturalistic setting; even though this was the setting of a research lab, for the researchers whose behaviour was being probed, the office was the habitual place of work; the test was trying to elicit people's reactions about the length of the cable, so in that respect, it aimed to observe

behaviour. To do so the test was conducted in a systematic, controlled way by cutting the cord a little bit at regular intervals.

4.2 Output of design ideas

The previous section talked about gathering data about the design context (user, activity and environment). We can consider this data as a form of *input* into the design process as a whole. This data can be used by the designers and helps them come up with ideas for designs that they can then discuss with users and other stakeholders. These design ideas, often in the form of sketches or prototypes, can be considered the *output* of the interaction design process.

Essentially, through making sketches and prototypes, designers have developed ways to help them express their understanding of the design context as it evolves and to convey their designs. For designers, these are a way to externalise their thinking, making their ideas visible and therefore available to others for scrutiny and discussion. This is why sketching and prototyping play such an important role during the designers' process of conceptualisation: they allow designers to verify their ideas, test these with users, and give users and other stakeholders the opportunity to get actively involved in the design process.

Sketching and prototyping techniques

Consider the examples we have discussed throughout this course. In Section 1 Activity 4, you were asked to provide some simple sketches of alternative designs for a device, such as a phone or a remote control. These simple sketches enabled you to explain how you were thinking of changing the device to one that would be usable by people with limited dexterity in their hands or people wearing gloves. When you started your sketch, you were possibly not entirely sure how you wanted the new device to look like and to work. However, by trying to sketch it, you came up with ideas and began to see new possibilities.

There is a wide range of sketching and prototyping techniques that can help explore different aspects of a design. Some focus on capturing design context by sketching typical users, actions, or settings. When discussing Jane and Craig in Section 3, you were provided with a photo of the user and parts of a conversation to help you understand and reflect on the design context. A similar effect might have been achieved with a simple sketch of two users, contrasting the way they carry out their activity, as shown in Figure 20.
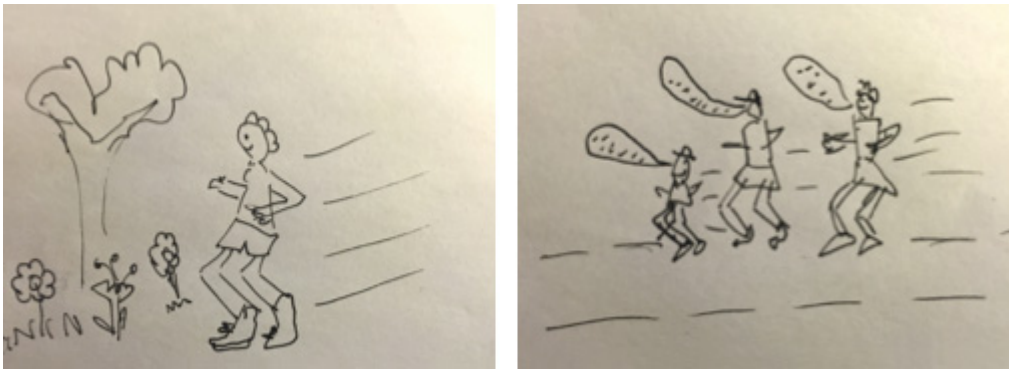
Figure 20 Two simple sketches depicting Jane (on the left) running by herself through nature, and Craig (on the right) running with his family while chatting

While simplistic and crude, the sketches can help focus a discussion around the important requirements of the two users and bring out their differences.

Other approaches focus on capturing designs, by sketching or prototyping interfaces and interactions. As designers' conceptualisations become more concrete and precise, so do their sketches and prototypes, tending to develop from rough sketches to detailed prototypes. Prototypes are said to be of low fidelity or high fidelity depending on how similar their functional and aesthetic characteristics are to the finished product. Low-fidelity prototypes, often 'rough-and-ready' sketches of incomplete design ideas, are especially useful in the early stages of the design process, when ideas are still fluid. The sketch you drew as part of Activity 4 is an example of a 'low-fidelity' prototype.

At other times, designers might use higher-tech prototypes that only focus on a specific aspect of the interaction, so they are still relatively simple and low fidelity. For example, if you wanted to define or test the sequence of actions necessary to set up a weekly training plan in a running app for Jane and Craig, you might need to code a simple mock-up of possible sequences; or if you wanted to test whether vibration would be an effective way for a virtual coach to 'talk' to the users, you might need to hack together a simple physical prototype using a small vibrating motor.

High-fidelity prototypes are where the different functional and aesthetic aspects of an interactive product come together, in the later stages of the design process, to give users a more precise sense of what their experience with the finished product will be like. Sometimes, it is at this stage, when a prototype provides a more realistic experience, that certain limitations with a design might become apparent for both users and designers.

Why sketching and prototyping is important

Sketching and prototyping prior to developing a product are important for a number of reasons, enabling and compelling designers to reflect on their understanding of the design context, its requirements and how such requirements might be met.

Reflecting on the design context: designers sketch the design context as well as potential designs. Doing so helps them to specifically consider the users, activities and environment. It also helps them to articulate and evaluate their understanding. Design is often collaborative, and exploring different design choices through sketches and prototypes can help the team verify their collective understanding of the design context and how different requirements might be interpreted.

Investigating requirements: sketches and prototypes also allow designers to investigate requirements. They allow prospective users and other stakeholders to engage with the

designers' ideas and provide feedback on the extent to which their requirements are represented. Furthermore, the use of prototypes can help uncover requirements which neither interaction designers nor users and other stakeholders were aware of before. Identifying requirements without the use of prototypes may be difficult or even impossible: interaction designers may not think of certain questions; users and other stakeholders may not know how to express their requirements, or they may not be sure or aware of what they need, until they have something to look at or use and to which they can respond. Consider the Smart Glass example and how the problems with the audio alert emerged as a result of the prototype.

Exploring design alternatives: exploring different ways of meeting requirements is another key function of designing and prototyping. In practice, interaction design is often about trying to meet requirements that may seem difficult to reconcile. For example, Craig may think that audio feedback from his running app is a good idea, but when he tries a prototype, he may find that audio interferes with his conversations with other runners. By exploring and prototyping different design ideas, designers may find suitable trade-offs. There may be no perfect solution, but exploring and prototyping a range of possibilities increases the chances of developing an interactive product that meets the requirements of users in the best possible way. For example, for Craig, a combination of vibrating and text might be a better way of providing feedback.

Evaluating: just as sketches and prototypes help prospective users provide feedback on the extent to which their requirements are represented, they also allow prospective users to engage with designs and provide feedback on them. Working with prototypes can reveal unexpected usability issues. For example, think about Sarah Wiseman's account of how the designers of the telephone keypad used sketches to evaluate different interface configurations.

Indeed, the interaction design process can be described as a gradual progression from concept sketching through prototyping of increasing fidelity, to the finished product, with some back and forth between sketching and detailed designing, and between low- and high-fidelity prototyping.

4.3 Iteration and interrelated activities

We've talked repeatedly about the four core activities for interaction design: establishing requirements, designing alternatives, prototyping designs, and evaluating prototypes. In practice, the four activities are not strictly separated but overlap with and inform each other, and they need not be conducted in a strict sequence.

The activities of evaluating and gathering requirements go hand in hand. When I am evaluating an existing product, which may have some flaw or which may need updating, I am effectively gathering requirements for the new version of the product through evaluation.

Consider again some of the examples you've encountered in this section:

- Evaluating existing products (as you did in Activity 2) can be a starting point to understanding requirements for a new product.
- In Activity 4 in Section 1, you thought of alternative designs to accommodate limited dexterity when using a phone or remote control, and you sketched rough prototypes of your design ideas.

- Evaluating the Smart Glass revealed less obvious requirements, such as maintaining the user's privacy.
- Evaluating a running app with different users (as in Section 3) can reveal different needs as well as problems with usability.

Note that establishing requirements and evaluation are largely concerned with the design context, and in particular the users' needs and interaction. In contrast, designing and prototyping are largely concerned with the designers' conceptualisation of the interaction.

We tend to think of design in rather concrete terms, in the form of designed objects or products. In fact, every well-designed object or product is the result of a careful process of conceptualisation. The Smart Glass was an imaginary product, described in the text and illustrated in a drawing. Understanding the example relied on you imagining and conceptualising not just the product, but crucially the users' interaction with it.

Making sense of all the complexities of the design context (for example, which users, with which constraints, doing which activities, where, in which social setting), in order to accommodate the key requirements in an interactive product, is a non-trivial task. The necessary understanding of the design context (i.e. user, activity, environment) can only be achieved incrementally through multiple design iterations, and in particular through the iteration of and dialogues between the interaction design activities.

The interrelationships between interaction design activities is captured (in a simplified form) in Figure 21.
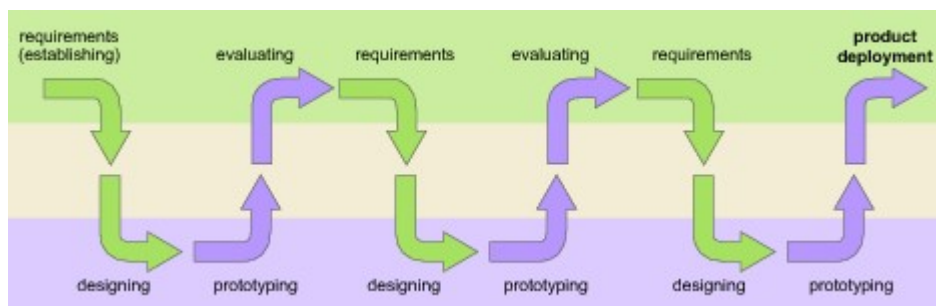

Figure 21 The dialogue between the four interaction design activities that leads iteratively to the development of the interactive product

The methods discussed earlier can provide input to help a designer start conceptualising an interaction, providing insight into potential users, their activities, and how the environment might affect the interaction. What type of interface might enable the users to make the most of their interaction with the product? The process of conceptualisation needs to balance the designer's openness and creativity (expressed through designing and prototyping) with the designer's systematic attention to and analysis of the design context (establishing requirements and evaluating).

While the iterative process may start with some simple gathering of information to help form an initial idea of what is required, the activity can then move between designing and evaluating several times. Each time we evaluate a prototype design, we are in essence refining the requirements. Having refined them, they can be used to develop a new prototype product which can in turn be evaluated, and so on until a stable point is reached when enough is known about the design. At that point, the process may change to one of production and deployment of the product.

The *design life cycle* (i.e. this iterative movement among the four interactive design activities to reach an interactive product design) is not prescriptive. That is, there is no

convention that says that a product should have gone through a specific number of design iterations. Nor is it the case that designers have unlimited time available to iterate endlessly.

Note that, for most interactive products, their design life cycle does not end at the moment they are deployed. After time, a company may decide it is time to launch a new version of the product with improved features. These features may have emerged through real people using the product over time and identifying new uses, new scenarios and hence new requirements that should be added.

The relationships between the main activities of the interaction design process could be summarised in the following diagram.
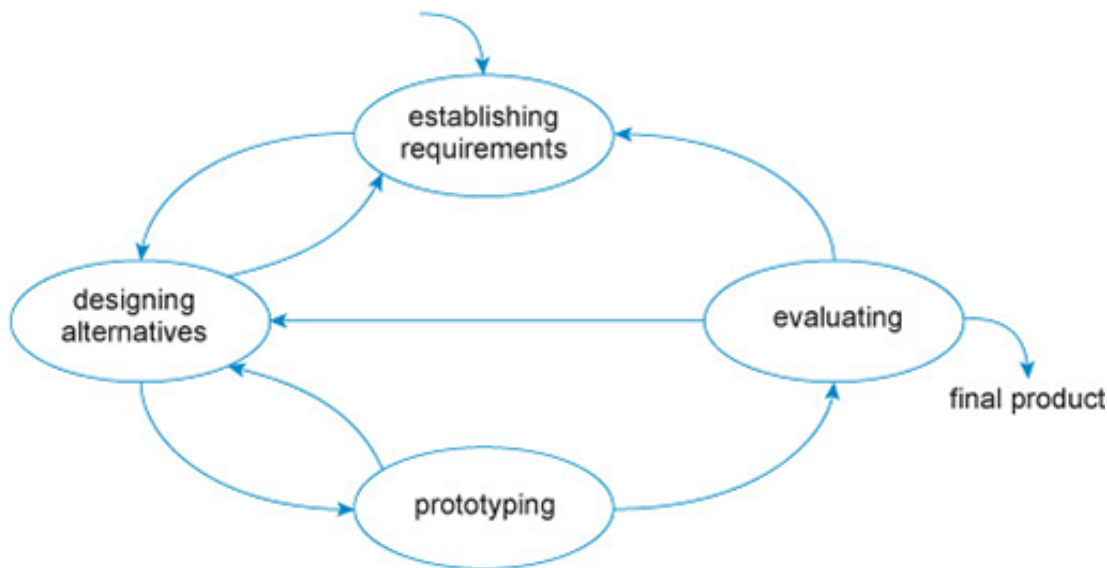

Figure 22 The relationships between the main activities of the interaction design process. Source: Preece et al. (2015) p. 332

4.4 Interaction design as a discipline

So far we have talked about interaction design as a process defined by specific activities and characteristics. However, more broadly, interaction design is a field of expertise to which a variety of disciplines contribute, such as psychology, sociology, graphic design and product design.

Because it is difficult for one person to be an expert in all relevant disciplines, interaction design benefits from the collaboration of a multidisciplinary team, where different experts contribute to the process. For example, psychologists can offer important insights into the way in which prospective users might perceive and understand elements of an interface, while social scientists can help predict and assess how certain designs might influence prospective users' social relations; designers can create interfaces that look beautiful, while engineers can figure out what technological solutions might be most appropriate to implement the functionalities of the system represented by the interface. This course also aims to give you tools to assess if and when other competences are needed for a specific project, so that you can seek them out.

In discussing the different ways in which the interaction design process can play out for different projects, we have so far focused on the individual project and its life cycle. However, even if a project formally has a beginning and an end, no project ever takes

place in a vacuum but rather within the wider sociocultural and economic context in which countless interactive products are continuously developed. An interactive product never starts out of nothing and it is rarely ever really finished: any new product is likely to be influenced in one way or another by already existing products, and it is likely to continue to evolve into new versions well after it reaches the market.

Indeed, in reality, design thinking precedes and continues beyond the single interaction design project. This ongoing dialogue involves, on one hand, countless interactive products as well as the people who created them, and on the other hand, those who use them or who are otherwise affected by them. We encourage you to be mindful of this continuous dialogue and its importance. Rather than tackling an interaction design project as an isolated process, you can find inspiration and learn from other products and projects. You can build on what already exists to create something new that others can recognise as familiar yet novel.

Section 4 summary

Section 4 has offered a general introduction to the interaction design process that combines the activities introduced in Section 1 with some data gathering methods. In particular:

- We presented an overview of different types of methods for collecting data on user behaviour and user experiences (including asking the users and observing the users) in order to gain insights into interaction design.
- We discussed designing and prototyping as the other side of the coin, as the activities in which designers conceptualise their ideas and make them concrete through sketches or prototypes, in order to communicate these ideas to others and get their input.
- We discussed the interaction design life cycle, in particular pointing out that the four interaction design activities are interrelated and iterative.
- We 'stepped back' briefly to consider interaction design as a discipline within a broader professional context, not just as a process.

Conclusion

This free course, *An introduction to interaction design*, has introduced you to interaction design in a broad sense – from the scope and importance of interaction design, to core concepts such as a user-centred approach, usability and user experience. It has provided an overview of the interaction design process and its four key activities:

1. establishing requirements
2. designing alternatives
3. prototyping
4. evaluating.

The course should have enabled you to achieve the following learning outcomes:

Having acquired knowledge and understanding of:

1. *What interaction design is about and the importance of user-centred design; and methods that take into account activities and tasks, context of use and user experiences.*The sections and activities throughout this course have introduced you to examples of interactive products and to the importance of user-centred design. Section 2 in particular focused on user-centred design; it discussed usability and user experience goals, as well as fundamental design principles. Section 3 focused on specific aspects that characterise the design context: the characteristics of the user, the nature of the activity in which users engage, and the environment in which the interaction takes place.

2. *The sensory, cognitive and physical capabilities of users and how these inform the design of interactive products.*Through the hands-on activity in Section 1 you were made aware of the importance of taking the user's physical capabilities into account. This topic was discussed in more depth in Section 3, with a focus on users' capabilities and how these need to be taken into account when designing interactive products. Section 3 explored this further, addressing not just physical, sensory and cognitive capabilities, but also background and experience. Further, Section 3 discussed user characteristics as part of a larger design context that also includes activities and environment.

3. *The process of interaction design, including requirements elicitation, prototyping, evaluation and the need for iteration.*Section 1 introduced the core activities of the interaction design process: establishing requirements, designing alternatives, prototyping designs and evaluating prototypes. Section 4 discussed how it is only by involving the user in this process and iterating its activities that designers can really come to understand the user, their context and their needs, and therefore design a usable and useful interaction.

Having acquired the following cognitive skills:

1. *At least, to some extent, analyse and critique the design of interactive products.* Section 1 introduced activities that encouraged you to develop your ability to analyse and critique the design of interactive products from different perspectives by putting yourself in 'different shoes'. Section 2 introduced design goals and principles and described a case study that illustrated the sorts of problems that arise when those are ignored, giving you a chance to reflect on the goals and principles. Section 3

asked you to reflect on user needs, as well as the effect of activities and environment on the interaction, using a case study contrasting two users.

2. *At least, to some extent, select, adapt and apply suitable interaction design approaches and techniques towards the design of an interactive product.*During the course activities, you have begun to apply some simple methods (e.g. asking users, sketching, rough prototyping) towards the design of an interactive product.

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