Users Perspective of Educational Technology

5

Chapter Outline

- User experience
- User-centered design
- Learner-centered design
- The ARCS Model of motivational design.

By the End of This Chapter, You Should Be Able To

- Define user experience and user-centered design
- Differentiate user-centered design and learner-centered design
- Recall the honeycomb model for designing user experience and the ARCS model of motivational design
- Clarify the processes and principles of user-centered design
- Provide advice on how to involve users in the design and how to carry out learner-centered design.

Main Learning Activities

1. Think about why user experience (UX) should be considered for educational technology system and products, and what kind of components should be taken into consideration to design UX for educational technology system and products? Give specific examples.
2. Think about what you will do step by step to design an educational technology product, like an APP? Try to use a specific example even if is imaginary. For example, you might use a critical thinking game for kids as the example.
3. Think about the users for one educational technology product; if the product can be redesigned, what suggestions can you provide for designers to improve the

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product by involving users? When and how would you recommend involving them?
4. Think about differences between users and learners? Consider this in terms of a specific technology. What are their different perspectives? How to consider learners' special needs in designing an educational technology system? You might use a product such as Microsoft Word to illustrate your ideas.
5. Think about what is the differences between user and learner motivation in using a specific product. Describe the product and specific uses. How can one go about considering a variety of user and learner needs in designing an educational technology system?

5.1 Introduction

The previous chapter discussed a systems' perspective of educational technology. Educational technology can be regarded as a system with a variety of components and relationships. As we know, educational technology systems aim at improving user's performance, and users could include students, teachers, parents, support personnel, administrators, and policy makers. Different users may have different perspectives and concerns, and thus user's perspectives play a vital role for the success of educational technology systems.

In software engineering, user-centered design and development are now standard practice with an emphasis on rapid prototyping and getting input from representative users. Taking the typical models of user-centered design in software engineering as a reference and considering the research of user-centered design in educational technology, the following sections will introduce the users' perspective of educational technology. Emphasis is on user experience, user-centered design, learner-centered design, and the ARCS motivation model.

5.2 User Experience

Definition

User experience (UX) is defined as "a person's perceptions and responses that result from the use or anticipated use of a product, system or service" (International Organization for Standardization, 2009). From to this definition, UX includes all the users' attitudes, emotions, perceptions, preferences, physical/psychological responses, and behaviors that occur *before, during, and after use.* The ISO also lists *three factors* that influence user experience: system, user, and the context of use.

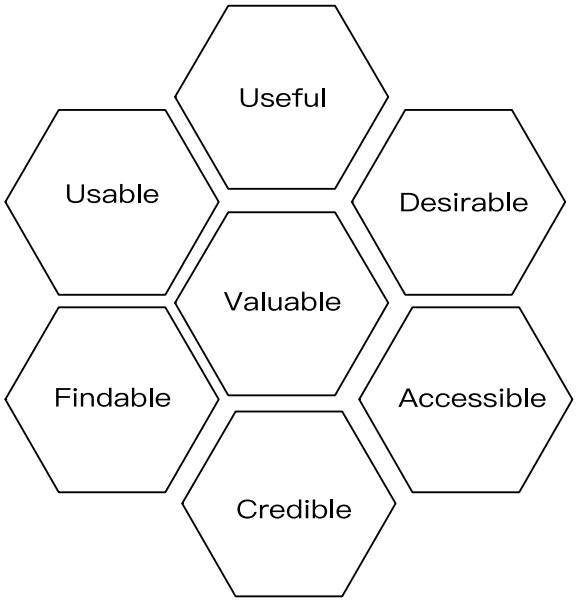

Fig. 5.1 User experience honeycomb. Adapted from Molville (2004)

User Experience Honeycomb

Morville (2004) created a frequently reproduced honeycomb model to design for user experience that illustrated the facets of user experience (see Fig. 5.1), especially to help clients understand why they must move beyond usability.

The user experience honeycomb could be used as a guide to explain the various facets of the design of user experience. Morville (2004) believed that the user experience honeycomb would contribute to educating clients, which helps them to find a sweet spot between the various areas of a good user experience. If applied in educational technology, the essential items could be explained as follow:

Useful. An educational technology product or service should fulfill teachers'/students'/parents' needs. If the product or service could not fulfill user's wants or needs, then there is no real use for the product itself.

Usable. Systems in which the product or service is delivered should be simple, familiar, easy to understand and easy to use. The learning curve that users must go through should be as short and painless as possible.

Desirable. The visual aesthetics of the educational product, service, or system should be minimal, attractive, and easy to understand. Our pursuit of efficiency must be moderated by an appreciation for the power and value of the brand, image, identity, and other elements of emotional design.

Findable. Information in the educational technology systems needs to be findable and easy to navigate. If teachers/students/parents have a problem, they should be able to find a solution quickly. The navigational structure must be set up in a way that takes users' behaviors and habits into consideration to makes sense.

Accessible. The product or services should be designed so that even users with disabilities can have the same user experience as others.
Credible. The enterprises and their products or services need to be trustworthy.
Valuable. Our products or services should deliver value to sponsors. For nonprofits, the user experience must improve the mission of the enterprise. With for-profits, it should contribute to the bottom line and increase customer satisfaction.

Take a Web site design as an example. The content should be original and fulfill some users' needs (**useful**). The site must be easy to use (**usable**). The design elements (like the brand) are used to evoke emotion and appreciation (**desirable**). The content needs to be navigable (**findable**), and they should be available even to people with disabilities (**accessible**). Users must trust the content and the brand (**credible**).

The honeycomb model helps to find all the areas that are essential to a good user experience and can be broken down into more specific aspects. As an educational technology system/product designer, we could use the honeycomb model to outline and define all the areas that are relevant to user experience (UX) design, and ask ourselves the following questions. Is it more important for our system to be findable? Is it desirable to use? Which of those two concerns need to be addressed first? Do we need to improve credibility in our market? Is our product or service accessible? So on and so forth.

5.3 User-Centered Design

Definition
The term "user-centered design (UCD)" was used in the 1980s in Donald Norman's research laboratory at the University of California San Diego and became widely used after the publication of the book entitled: *User-Centered System Design: New Perspectives on Human-Computer Interaction* (Norman & Draper, 1986).

Landauer (1995) defined UCD as "design driven, informed, and shaped by empirical evaluation of usefulness and usability" (p. 221). Later, Karat (1997) defined UCD as "an iterative process whose goal is the development of usable system… achieve through the involvement of potential users of a system in system design. It captures a commitment that you must involve users in system design" (p. 38).

From the two definitions, we see that UCD is a broad term to refer to the design processes in which users influence how a design takes shape.

User-Centered Design Process
UCD is both a broad philosophy and a series of methods. Lots of techniques could be used to involve users in UCD, but the important concept is that end users should

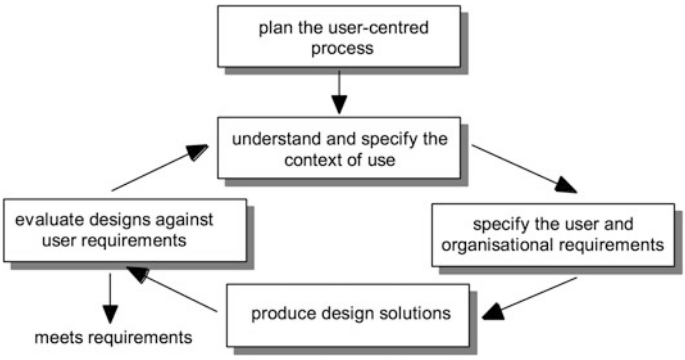

Fig. 5.2 Iterative process of UCD

be involved one way or another in the design process. For instance, users may be consulted about their needs and be involved at different stages during the design process, such as the requirements gathering process or the usability testing process. In some types of UCD methods, users may have a deep impact on the system/product design by being involved throughout the design process.

UCD is an *iterative* design process, whereby a prototype is designed, tested, and modified. The iterative process based upon the design cycle presented in the user-centered design draft standard ISO 13407 (see https://www.iso.org/standard/21197.html) was shown in Fig. 5.2. These days, this process is often called design-based research (see Chap. 11).

In the process of planning UCD, the following four activities is the key to success.

1. Understand and specify the context of use: Identify who will use our product, what is the purpose of using it, and in which conditions they will use it.
2. Specify the user and organizational requirements: Identify any business missions or end-user needs that must be met for our product to become successful.
3. Produce design solutions: This step should be a spiraling process, building from a rough concept to a complete design.
4. Evaluate designs against user requirements: The evaluation to see if our product meet user's needs—usually through usability testing with actual users—is as important as quality testing to good software development.

User-Centered Design Principles

In the above iterative process of UCD from ISO 13407, the following six principles should be considered by UCD managers.

1. The design should be based on clear understanding of environments, users, and tasks.

2. Users should be involved throughout the design and development process.
3. The design should be driven user-centered evaluation and then refined by user-centered evaluation.
4. The design process should be iterative.
5. The design should address all the areas of user experience.
6. The design team should include multi-disciplinary skills and perspectives.

Norman (1988) proposed the following *seven guiding principles of design* to ensure useful and usable products.

1. **Use both knowledge in the world and knowledge in the head**. Build conceptual models based on research and investigation, write manuals before the design is implemented, and make sure the manuals are easily understood.
2. **Simplify the structure of tasks**. Understand that users can only remember five things at a time on average and therefore not to overload their short-term memory. It is important to provide mental aids for easy retrieval of information from long-term memory. Make sure the user has control over the tasks, and the tasks should be consistent.
3. **Make things visible to facilitate execution and evaluation**. The user should be able to figure out the use of an object by seeing the right buttons or devices for executing an operation.
4. **Make the connection of operations obvious**. One way to make connections of functions understandable is to use graphics.
5. **Exploit the power of constraints**. These can be both natural and artificial, and their use gives the user the feeling that there is one thing to do.
6. **Design for error**. Plan for errors to be made by users; one way to do this is to provide allowed the option of quick and easy recovery from any possible error made.
7. **When all else fails, standardize**. Create an international standard if something cannot be designed without arbitrary mappings (Norman, 1988).

Norman's work stressed the need to fully investigate the desires and needs of the end users and the possible uses of the product. Users became a central part of the product development process. Their involvement will contribute to more effective, efficient, and safer products and lead to the acceptance and success of our products (Preece, Rogers, & Sharp, 2002).

Involve Users in the Design

In order to involve users in the design, the first and most important task is to identify who is the user. Eason (1987) proposed three kinds of users: primary, secondary, and tertiary users. *Primary users* are those who actually use the product; *secondary users* are those who will occasionally use the product or those who use it through a mediator; *tertiary users* are those who will be affected by the utilization of the product or make decisions about its purchase. The successful design of a

Table 5.1 Ways to involve users

Technique	Purpose	Stage of the design cycle
Background Interviews and questionnaires	Collecting data related to the needs and expectations of users; evaluation of design alternatives, prototypes, and the final artifact	At the beginning of the design project
Sequence of work interviews and questionnaires	Collecting data related to the sequence of work to be performed with the artifact	Early in the design cycle
Focus groups	Include a wide range of stakeholders to discuss issues and requirements	Early in the design cycle
On-site observation	Collecting information concerning the environment in which the artifact will be used	Early in the design cycle
Role playing, walkthroughs, and simulations	Evaluation of alternative designs and gaining additional information about user needs and expectations; prototype evaluation	Early and mid-point in the design cycle
Usability testing	Collecting quantities data related to measurable usability criteria	Final stage of the design cycle
Interviews and questionnaires	Collecting qualitative data related to user satisfaction with the artifact	Final stage of the design cycle

product must consider the wide range of stakeholders/users of the product. Not everyone who is a stakeholder needs to be represented in a design team, but the effect of the product on them must be taken into consideration (Preece et al., 2002).

After the stakeholders have been identified, a thorough investigation of their needs should be conducted by doing tasks and needs analyses (Clark & Estes, 1996). Then, designers can develop alternative design solutions to be evaluated by the actual users. In both the design process and evaluation process, users should be involved in. Ways to involve users in the design, development, and evaluation of a product were shown in Table 5.1 (Preece et al., 2002).

5.4 Learner-Centered Design

Comparing with UCD, learner-centered design (LCD) emphasizes the importance of supporting students' growth and their motivational needs in designing educational software. Learner-centered indicates a move from ease-of-use issues toward the development of a student's comprehension and expertise. Table 5.2 shows the difference between users and learners.

- Users have the expertise in their work domains, and they understand the tasks they are accomplishing. Learners do not have the same domain knowledge as

Table 5.2 Difference between users and learners

Professional users	Learners
High expertise in the task domain	Low expertise in the task domain
Homogenous population	Diverse population
Higher motivation to engage in their tasks	Lower motivation to engage in their tasks
Little change in users	Learner develop and grow and they learn
Design of their tools should primarily address gulfs between user and tool (i.e., gulfs of execution and expertise)	Design of their tools should primarily address gulfs between their knowledge and knowledge of an expert in the task domain

the user. They have neither the expertise of the work area nor the understanding of specific tasks of a professional counterpart.

- Users are homogeneous. They are engaged in specific work activities and share the same work culture, so they can be considered homogenous in some meaningful ways (Soloway et al., 1996). Learners are heterogeneous. They may not share a common culture, background, or understanding, so designers must consider the differences in the background, the diversity of learning styles, and other kinds of varieties of the learners' groups.
- Users, by the nature of involvement in their work tasks, often have intrinsic motivations for their work, and tools do not have to provide any additional motivational incentives (Soloway et al., 1994). However, learners' intrinsic motivations may differ from those of experts. Besides, because learners lack understanding of the work area, they may face more obstacles in completing the task at hand, thereby reducing their motivation even more.
- Users do not necessarily need to learn about their work from the tools. Instead, they need tools to help them finish their work. However, learners should learn when they engage in a new field of work by using educational software. So their tools, just as the learners themselves, (i.e., their windows in the field of work) need to grow and change.
- User-centered design should address the conceptual distance between computer users and the computer (Norman & Draper, 1986). However, the learner-centered design should focus on the gulf of expertise that lies between novice learner and an expert in the knowledge domain.

So, if we putting learners at the center of the product design, the **special needs of learners** must be considered (Soloway et al., 1994):

1. **Understanding is the Goal**. When design the educational software, keep in mind that learners do not have the basic knowledge and skill in specific work domains. For example, they will not know the accounting principles or practices when a spreadsheet is presented to them. How will they learn to use that spreadsheet must be considered in the design process?
2. **Motivation is the Basis**. We cannot count on the motivation of learners. Remember that both students and professionals have a strong tendency to fritter

away time or to procrastinate, when they are confronted with a task that they are not familiar or unprepared for. The educational software should be designed to support the learner's wavering motivation.

3. **Diversity is the Norm**. Learners who use the specific tool are often from a diverse set of backgrounds, with various interests, skills, abilities, learning styles, etc. "One size fits all" will not satisfy the various needs of diverse learners.
4. **Growth is the Challenge**. Learners can be very different from day 1 to day 100. They may have learned quite a bit about a problem domain and might have developed a set of skills and practices in that domain; however, most of the software doesn't change and grow. The individual has changed, but the knowledge and the specific practices of a task in the software haven't.

Therefore, learner-centered design must follow *these basic tenets:*

- **Take learner's understanding as the result** (through coaching, modeling, and critiquing).
- **Create and maintain learner's motivation** (through low cognitive load and immediate success feedback).
- **Offer a wide range of learning techniques** (by using different media and different ways of expression).
- **Encourage the learner's growth** (through an adaptable product). In other words, good scaffolding should be designed for students, and the scaffolding is available when the student needs it, but not when they want to study independently. Motivation can also be sustained by putting learners in the context of doing, developing software that enables them to construct artifacts and communicate with others about those artifacts.

Another theory should be mentioned for designing learning experience, the universal design for learning (UDL), which is a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn. Recognizing that the way individuals learn can be unique, the UDL framework drew upon from neuroscience and education research, was first defined by David H. Rose in the 1990s (Rose and Meyer, 2002). UDL is a framework for developing lesson plans and assessments based on the following three main principles (Meyer, Rose, and Gordon, 2014):

- **Provide multiple means of engagement (the "why" of learning)**: UDL encourages teachers to look for multiple ways to motivate students. Letting kids make choices and giving them assignments that feel relevant to their lives are some examples of how teachers can sustain students' interest. Other common strategies include making skill building feel like a game and creating opportunities for students to get up and move around the classroom.
- **Provide multiple means of representation (the "what" of learning)**: UDL recommends offering information in more than one format. For example,

textbooks are primarily visual. But providing text, audio, video, and hands-on learning gives all kids a chance to access the material in whichever way is best suited to their learning strengths.

- **Provide multiple means of action and expression (the "how" of learning)**: UDL suggests giving kids more than one way to interact with the material and to show what they've learned. For example, students might get to choose between taking a pencil-and-paper test, giving an oral presentation, and doing a group project.

5.5 The ARCS Model of Motivational Design

The ARCS model of motivational design is a theory created by John Keller rooted in analyzing the motivational characteristics of learners. It is a problem-solving approach to design the motivational aspects of learning environments to promote and sustain students' motivation to learn (Keller, 1987).

According to the ARCS model, there are four interrelated phases for stimulating and sustaining learner's motivation in the teaching and learning process: Attention, Relevance, Confidence, Satisfaction (ARCS), as shown in Fig. 5.3.

(1) **Attention**

Attention in this theory refers to the interest of students in learning the concepts/ideas being taught. According to Keller (1997, 2009), there are two general ways to stimulate students' attention. (1) **Perceptual arousal** uses surprise or uncertainly to gain interest and uses novel, surprising, incongruous,

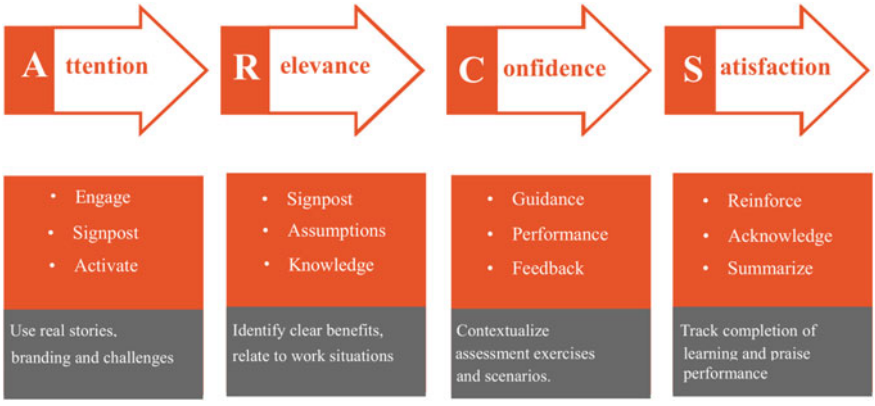

Fig. 5.3 ARCS model of motivational design. Adapted from Keller (2009)

and uncertain events; (2) **Inquiry arousal** stimulates curiosity by posing challenging questions or problems to be solved.

In details, designers or teachers could use the following six methods to gain the students' attention.

- **Active participation**: using strategies to get learners involved in the learning material/subject matter, such as games, role play or other hands-on methods.
- **Variability**: using a wide range of methods in presenting material to enhance presentation and account for diversity in learning styles, such as videos, short lectures, mini-discussion groups.
- **Humor:** using a small amount of humor to motivate attention (but not too much to be distracting).
- **Incongruity and conflict**: using statements that go against learners' past experiences to provoke conflict and incongruity.
- **Specific examples**: using a visual stimulus, story, or biography.
- **Inquiry**: posing questions or problems for the learners to solve, such as brainstorming activities.

(2) **Relevance**

According to Keller, relevance could be established to increase a learner's motivation, by using language and examples that the **learners are familiar with**. The following six major strategies could be used to establish relevance.

- **Experience**. Tell the learners how the new learning will use their existing skills. We best learn by building upon our preset knowledge or skills.
- **Present worth**. What will the subject matter do for me today?
- **Future usefulness**. What will the subject matter do for me tomorrow?
- **Needs matching**. Take advantage of the dynamics of achievement, risk taking, power, and affiliation.
- **Modeling**. First of all, "be what you want them to do!" Other strategies include guest speakers, videos, and having the learners who finish their work first to serve as tutors.
- **Choice**. Allow the learners to use different methods to pursue their work or allowing a choice in how they organize it.

(3) **Confidence**

Confidence in the ARCS model focuses on building positive expectations for achieving success among learners. Learner's confidence level is often associated with motivation and the amount of effort that they put in completing a performance objective.

In order to increase confidence, the following strategies could be considered.

- **Help learners understand their likelihood for success**. If they feel the objectives could never be accomplished or that the cost (effort or time) is too high, their motivation will shrink.
- **Provide objectives and prerequisites**. Help learners evaluate the probability of success through clarifying performance requirements and assessment criteria. Guarantee that the students are aware of performance requirements and assessment criteria.
- **Allow for success that is meaningful.**
- **Grow the learners**. Allow small steps of growing during the whole learning process.
- **Feedback**. Provide feedback and support internal attributions for success.
- **Learner control**. Students should feel some degree of control over their learning and assessment. They should believe that their success is a direct result of the amount of effort they have put forth on their learning.

(4) **Satisfaction**

Learners must be rewarded or satisfied in some way, whether it is the praise from a higher up, a sense of achievement, or mere entertainment.
The following three main strategies could be used to promote satisfaction.

- **Intrinsic reinforcement**. Encourage and support intrinsic enjoyment of the learning experience. Example: The teacher invites former students to provide testimonials on how learning these skills helped them with subsequent homework and class projects.
- **Extrinsic rewards**. Provide positive reinforcement and motivational feedback. Example: The teacher awards certificates to students as they master the complete set of skills.
- **Equity**. Maintain consistent standards and consequences for success. Example: After the term project has been completed, the teacher provides evaluative feedback using the criteria described in class.

Key Points in This Chapter

1. UX is a person's perceptions and responses that result from the use or anticipated use of a product, system, or service; system, user, and the context of use are the three factors that influence UX.
2. The honeycomb model to design for UX includes the seven elements of useful, usable, desirable, findable, accessible, credible, and valuable.
3. UCD is a broad term to describe design processes in which end users influence how a design takes shape. Understand and specify the context of use, specify the user and organizational requirements, produce design solutions, and evaluate

designs against user requirements are the four key activities for the success of UCD.
4. The principles of UCD include: The design is based upon an explicit understanding of users, tasks, and environments, Users are involved throughout design and development, the design is driven and refined by user-centered evaluation, and the process is iterative. The design addresses the whole user experience; the design team includes multidisciplinary skills and perspectives.
5. There are three types of users: primary, secondary, and tertiary. The differences of users and learners include their knowledge in the task domain, the homogenous population or diverse population, their motivation to engage in the task, the change of knowledge and skills, and the design focus.
6. The key strategies for LCD include: Understanding is the goal, motivation is the basis, diversity is the norm, and growth is the challenge.
7. There are four steps for promoting and sustaining motivation in the learning process: Attention, Relevance, Confidence, Satisfaction (ARCS) in the ARCS model for motivational design.

Learning Sources

User experience basics: https://www.usability.gov/what-and-why/user-experience.html
User experience honeycomb: https://medium.com/@danewesolko/peter-morvilles-user-experience-honeycomb-904c383b6886
ARCS model: https://www.arcsmodel.com
User-centered design: http://edutechwiki.unige.ch/en/User-centered_design
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