Curriculum Development Centers Program

Awardee of The Office of the National Coordinator for Health Information Technology

HEALTH IT WORKFORCE CURRICULUM
COMPONENT BLUEPRINT
Version 3.0/Spring 2012

Component Number: 15
Component Name: Usability and Human Factors

Component Description: Discussion of rapid prototyping, user-centered design and evaluation, usability; understanding effects of new technology and workflow on downstream processes; facilitation of a unit-wide focus group or simulation.

Assigned Institution: Columbia University
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Component Objectives:
Upon completion of this component, the student will be able to:
1. Articulate a systems approach to usability and human factors as it applies to health information technology.
2. Explain the cognitive consequences of health information technology on clinical performance.

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3. Identify the consequences of suboptimal design in the delivery of healthcare.
4. Apply methods of cognitive research, sources of usability evidence, and principles of user-centered design to decisions regarding systems evaluation, technology evaluation, and iterative design, given a population of users.
5. Apply requirements engineering methods to inform design and technology selection.
6. Demonstrate concept knowledge of cognition and human performance models in their relevance to systems evaluation methods.
7. Apply concept knowledge of cognitive, physical and organization ergonomics to human factors engineering.
8. Select the most appropriate usability evaluation method, given particular system, setting, and development phase.
9. Apply principles of usability and design to critiquing EHR systems and to making recommendations for iterative improvement.
10. Diagnose problems associated with a clinical decision support system.
11. Apply cognitive methods of analysis to medical device testing.
12. Evaluate user interface designs using cognitive methods of analysis, usability testing, and Nielsen's heuristic evaluation method.
13. Diagnose various types of error and create or select potential solutions.
14. Select appropriate technology input methods given different technology uses, user populations and contexts.
15. Describe how information visualization can support and enhance the representation of trends and aggregate data.
16. Describe the role of mobile and ubiquitous computing in healthcare.

Component Units with Objectives and Topics

Unit 1:
People and technology, studies of technology

Description:
Apply methods of cognitive research, sources of usability evidence, and principles of user-centered design to decisions regarding systems evaluation, technology evaluation, and iterative design, given a population of users.

Objectives:
Students will be able to:
1. Explain the importance of technology in health.
2. Describe the contributions of Human-Computer interaction to the Health field
3. Define the concept of system usability.
4. Describe the seven stages of User Activity in Norman's Theory of Action
5. Demonstrate concept knowledge of principles of user-centered design, methods of cognitive research, and sources of usability evidence.
6. Describe the role of human factors and human computer interaction concerning patient safety in the healthcare setting.

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7. Demonstrate concept knowledge of principles of user-centered design and sources of usability evidence
8. Identify the various types of errors in medicine
9. Identify patient safety issues

Topics:
A. Introduction to the studies of technology and Human-Computer Interaction
B. Norman's Theory of Action and Design of Everyday Things
C. The digital divide
D. Introduction to user-centered design
E. Basics of usability evaluation methods
F. Understanding users
G. Health technologies and the digital divide
H. To Err is Human: the scope of errors in medicine
I. Patient safety

Unit 2:
Requirements engineering

Description:
Apply requirements engineering methods to inform design and technology selection.

Objectives:
Students will be able to:
1. Explain the role of requirements gathering in usability evaluation.
2. Identify the uses, advantages, and disadvantages of data collection methods used for requirements gathering
3. Demonstrate an understanding of how to conduct a workflow analysis
4. Identify contextual design principles as they apply to the healthcare setting
5. Describe the methods to interpret results of data collection

Topics:
A. Requirements gathering
B. Contextual design
C. Interviews
D .Observations of work
E. Analysis of workflow
F. Analyzing qualitative data (affinity diagrams, process flows)

Unit 3:
Cognition and Human Performance

Description:
Demonstrate concept knowledge of cognition and human performance models in their

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relevance to systems evaluation methods.

Objectives:
Students will be able to:
1. Define the concept of cognitive engineering
2. Describe the representational effect as it applies to human computer interaction and web design
3. Describe how humans process information and obtain skills
3.1 Describe the Gestalt principles of perception and their relevance to human computer interaction and cognitive theory
3.2 Describe the processes of memory and their relationship to web-design
3.3 Describe the cognitive constructs for mental representation
4. Explain how cognition and human performance models should inform iterative design processes

Topics:
A. A model of human information processing
B. Basics of human cognition
C. Attention, perception and memory
D. Mental models and schemata
E. Representational effects
F. Distributed cognition
G. Skill acquisition
H. Implications for iterative design

Unit 4:
Human factors and healthcare

Description:
Apply concept knowledge of human factors to the evaluation of systems-design and the study of human errors and patient safety.

Objectives:
Students will be able to:
1. Distinguish between human factors and human computer interactions (HCI) as they apply to usability
2. Explain how cognitive, physical and organization ergonomics can be applied to human factors engineering
3. Describe how the concepts of mental workload, selective attention and information overload affect usability
4. Describe the different dimensions of the concept of human error
5. Describe a systems-centered approach to error and patient safety
6. Apply methods for measuring mental workload and information overload
7. Describe how human factors analysis can be applied to the study of medical devices

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Topics:
A. Introduction to human factors engineering
B. Cognitive, physical and organization ergonomics
C. Mental workload
D. Selective attention and information overload
E. The nature of human error and patient safety
F. Implications of human factors for medical devices

Unit 5:
Usability evaluation methods

Description:
Select the most appropriate usability evaluation method, given particular system, setting, and development phase.

Objectives:
Students will be able to:
1. Describe the importance of usability in relation to health information technologies
2. List and describe usability evaluation methods
3. Given a situation and set of goals, determine which usability evaluation method would be most appropriate and effective
3. Describe the appropriate tasks for a usability test
3. Describe the usability testing environment, required equipment, logistics, and materials
4. Conduct a cognitive walkthrough

Topics:
A. Why usability matters
B. Interviews
C. Focus groups
D. Questionnaires
E. Cognitive task analysis
F. Usability inspection methods
G. Cognitive walkthrough
H. Heuristic evaluation
I. Usability testing
J. Video-analysis

Unit 6:
Electronic health records and usability

Description:
Apply principles of usability and design to critiquing EHR systems and to making

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recommendations for iterative improvement.

Objectives:
Students will be able to:
1. Discuss the role of usability testing, training and implementation of electronic health records
2. Describe and define usability as it pertains to the EHR (HIMSS document)
3. Explain the challenges of EHR design and usability in typical workflow
4. Identify a set of well-established principles of usability and design and describe their application to EHRs (HIMSS document)
5. Identify and explain usability methods for enhancing efficiency of use and minimizing likelihood of user error (HIMSS document)
6. Explain how user-centered design can enhance adoption of EHRs
7. Describe Web 2.0 and novel concepts in system design
8. Identify potential methods of assessing and rating EHR usability when selecting an appropriate EHR system (HIMSS document)

Topics:
A. Electronic health records in medicine
B. Usability, training and implementation
C. Special case of computerized physician order entry
D. Effects of and effects with technology
E. Evaluating EHRs
F. Usability inspection
G. Heuristic evaluation
H. Usability testing
I. Focus groups
J. EHRs and user-centered design
K. Web 2.0 and novel concepts in system design

Unit 7:
Clinical decision support and usability

Description:
Diagnose problems associated with a clinical decision support system.

Objectives:
Students will be able to:
1. Understand the cognitive basis for decision making and its effect on clinical errors
2. Discuss the role of usability testing, training and implementation of clinical decision support
3. Describe and define usability as it pertains to clinical decision support
4. Identify examples of usability barriers to adoption of clinical decision support
5. Identify a set of well-established principles of usability and design and describe their

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application to clinical decision support

Topics:
A. Understanding Human Decision Making
B. Clinical Decision Support Systems (CDSS)
C. Computer Provider Order-Entry Systems and CDSS
D. Promise and pitfalls
E. Factors
F. Barriers
G. Improving Design

Unit 8:
Approaches to design

Description:
Characterize the multifaceted nature of the design process and evaluate whether a given user interface embraces sound principles of design to support usability goals

Objectives:
Students will be able to:
1. Explain a user-centered design approach
2. Define conceptual models
3. Explain the iterative design process
4. Describe requirements analysis and cognitive task analysis
5. Characterize the role of prototypes in design
6. Describe the principles of participatory design
7. Describe principles of sound design to support usability
8. Describe how Nielsen's heuristics and design principles apply to user interface design
9. Explain the difference between low fidelity and high fidelity prototypes and when it would be appropriate to use one versus the other

Topics:
A. Translating requirements into design
B. Nielsen's heuristics and design principles
C. Classification exercise (card sorting)
D. Participatory design
E. Low fidelity prototypes
F. High fidelity prototypes
G. Iterative design
Unit 9:
Ubiquitous Computing

Description:

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Describe the role of mobile and ubiquitous computing in healthcare

Objectives:
Students will be able to:
1. History of Ubiquitous computing and basic principles
2. Describe the role of mobile and ubiquitous computing in healthcare
3. Describe some of the technical Challenges

Topics:
A. Context-sensitive applications
B. Mobile platforms in the hospital
C. Information access, decision support and mobile EHRs

Unit 10:
Designing for safety

Description:
Diagnose various types of error and create or select potential solutions.

Objectives:
Students will be able to:
1. Define “workflow analysis” and methods for examining and addressing human errors
2. Design a workflow analysis study
3. Identify common sources of error documented in research studies in medicine
4. Apply the cognitive taxonomy of errors
5. Apply principles underlying the design of healthcare systems for safety

Topics:
A. Workflow analysis
B. Sources of error in medicine
C. The case of intensive care medicine
D. Cognitive taxonomy of error
E. Designing for safety

Unit 11:
Input and selection

Description:
Select appropriate technology input methods given different technology uses, user populations and contexts.

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Objectives:
Students will be able to:
1. Provide a rationale as to why input methods are an important consideration in the design process for health technology
2. Compare and contrast technology input methods
3. Select appropriate technology input methods given different technology uses, user populations and contexts

Topics:
A. Pen input, voice, gesture
B. Beyond menu structures (pie menus, etc.)
C. Context-sensitive menus

Unit 12:
Information visualization

Description:
Describe how information visualization can support and enhance the representation of trends and aggregate data.

Objectives:
Students will be able to:
1. Identify/describe the role of information visualization and describe its purpose in enhancing usability of health technology.
2. Describe how information visualization can support and enhance the representation of trends and aggregate data

Topics:
A. Purpose of information visualization
B. Scientific visualization, information visualization
C. Representing trends and aggregate data

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Unit Elements:
Instructors manual, self-assessment questions, and application activities

Format:
Slides with narration, suitable for lecture, team-based learning, or online independent study

Size/Contract Hours:
12 units; each with approximately 20-25 minutes of lecture; approximately ½ hour homework per unit

Local Resources Required for Implementation:
Computer; Internet connection (optional/recommended); Computer speakers; Flash & multimedia player capabilities (optional/recommended)

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