

Unit 23: Human Computer Interaction

Unit code:	T/601/7326
QCF Level 3:	BTEC National
Credit value:	10
Guided learning hours:	60

● Aim and purpose

The aim of this unit is to ensure learners know the impact Human Computer Interaction (HCI) has on society, economy and culture provides the basic skills and understanding required to enable learners to design and implement human computer interfaces.

● Unit introduction

Human Computer Interaction (HCI) deals with the way people use technology. How do we give information to, and receive information from, computers and other digital devices? One of the biggest changes in the last 20 years has been the introduction of the graphical user interface and in many respects this has revolutionised the ways in which we interact with computers.

HCI is not confined to PCs. Consider a mobile phone or self-scan supermarket checkout. These have carefully designed user interfaces to make them easier and faster to use. There are a number of broad definitions of HCI and these confirm that HCI is not confined to technical computing, and that the subject crosses many boundaries. It could be included in the study of philosophy, engineering, psychology, physiology, behaviour and many other areas.

Firstly, this unit explores the impact of HCI on society, the economy and culture and looks at how HCI has developed and where it might be going next.

The fundamental principles involved in designing user interfaces are discussed, with particular emphasis on perception, behaviour models and information processing. Specialist needs and the adaptation of interfaces to meet these varied needs will be examined.

Secondly, the unit combines elements of HCI theory with learners' practical skills to enable them to design and implement user interfaces for input and output, using a programming language of choice. Learners will evaluate interfaces and measure their effectiveness both quantitatively and qualitatively.

This unit could be combined with other units involving software development.

● Learning outcomes

On completion of this unit a learner should:

- 1 Know the impact of HCI on society, the economy and culture
- 2 Understand the fundamental principles of interface design
- 3 Be able to design and implement user interfaces.

Unit content

1 Know the impact of HCI on society, the economy and culture

Development: early designs eg restricted by hardware, designed to assist programmers; extended command line editor (CLE); graphical user interface (GUI) eg as used in Microsoft Office; web user interface (WUI); visual systems eg modern applications software; specialised interfaces eg for the visually impaired; areas of present and future development eg fully 3D interfaces, comprehensive voice recognition, thought input, realistic virtual reality

Society: improve usability eg reduce specialised knowledge, simplify input/output, user friendliness, domestic appliance displays; specialised interfaces eg for those with sight or speech problems; interfaces for hostile environments eg remote control, data logging; complexity eg fly by wire, virtual reality, head up displays

Economy: productivity per individual eg speed up inputs, reduce complexity of input; increase automation eg reduce human input, text readers, automatic judgement of output, voice input, thought input; varied working environment eg mobile communications

Culture: the ways in which people use computers eg laptops, mobile phones, texting, mobile entertainment, mobile computing, domestic appliances, games; psychological and sociological impact eg impact of de-skilling work, impact in the developing nations

2 Understand the fundamental principles of interface design

Perception: colour eg trichromatic system, luminance, 'pop out' effect; pattern eg proximity, continuity, symmetry, similarity, common groupings, connectedness; objects eg geons, use of gross 3D shapes

Behaviour models: predictive models eg reaction time, Keystroke Level Model (KLM), ThroughPut (TP), Fitts' Law; descriptive models eg Key-Action Model (KAM), Buxton's three state model, Guiard's Model

Information processing: humans as a component; overview of human information processing (HIP); overview of goals, operators, methods and selection (GOMS)

Specialist: design for specialist uses eg input or output for the visually, orally, aurally or physically challenged, remote control devices, head up displays

3 Be able to design and implement user interfaces

Input: keyboard/mouse/monitor eg minimise keystrokes and mouse movements, logical sequencing, dexterity required; use of other input devices eg concept keyboard, voice input, joystick, touch screen; designs for other devices eg mobile phone, personal digital assistant (PDA), digital audio broadcasting (DAB) radio

Output: monitor or print eg logical sequence, layout, colour, orientation; use of other devices eg voice output, projector/interactive whiteboard

Testing: user testing; against original specification; working within a closed system; working in wider system; recording tests

Documentation: design eg picture boards, rich picture diagrams, flowcharts, structured charts; narrative eg original specification, description of how result achieved; test log

Quantitative measures of effectiveness: speed eg input speeds, keying speeds, throughput, speed of comprehension of output; comparative costs eg running costs, costs of staffing; comparison with original needs eg how many features are fully, partially, or not included; comparison with other systems

Qualitative measures of effectiveness: user satisfaction eg ease of use, skills required, usefulness of results, meets requirement; comparison with other systems eg in what way is the new better than the old

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P1 describe the impact of HCI on society, the economy and culture		D1 evaluate the impact of a potential future development in HCI [CT3]
P2 explain the fundamental principles of HCI design	M1 explain how an HCI could be adjusted for specialist needs [IE1]	
P3 design input and output HCIs to meet given specifications [CT1]	M2 explain the fundamental principles which have been applied to the designs	
P4 create input and output HCIs to meet given specifications		
P5 test the HCIs created [IE4]	M3 explain how the effectiveness of HCIs may be measured. [IE2]	
P6 document the HCIs created.		D2 evaluate the HCIs developed. [RL5]

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

The suggested delivery pattern follows the order of the learning outcomes in the unit. This is not the only order which may be used and tutors can follow their own preference.

A good place to start delivering the unit is to discuss how HCI has developed over the years. Directed research is a useful tool in delivering this part of the unit content, together with some whole-class teaching and tutor demonstrations of various aspects, as available. Simple case studies showing some differing needs of HCI would also be of benefit. Final discussions in this area focus on where HCI goes to next. This is a good area to cover in small-group discussions with feedback to the whole class.

When delivering the impact of HCI on society, getting discussion groups to look at how HCI has affected learners themselves is a good opening for more in-depth learning. Discussions should not be limited to computer systems but should also look at domestic appliances, mobiles and as many items similar to the indicative unit content as possible. Case studies are a useful resource.

To help discuss the impact of HCI on the economy and productivity in particular, practical exercises can be undertaken using different types of input including drop down menus for selecting pre-determined items versus keying in those items, different sequences of input etc. Actual productivity calculations can be carried out for comparison purposes.

Culture has a lot to do with how people use technology. If possible, it is quite useful to observe how and where people use technology using checklists to note what, when, where, etc. Directed research using the internet is useful to find information on mobile technology and psychological and physiological considerations.

When discussing design, a good place to start is with some basic ideas on perception. Simple exercises can be undertaken using combinations of colours and/or shapes, grouping information which is related and grouping non-related information, etc. When discussing behaviour models, learners should develop a sense of what these models provide rather than a detailed knowledge of the theory only and that it exists and that they have an idea of what it might be used for.

The main emphasis with information processing is to ensure that learners are aware that humans work in particular ways using their own language, whilst technology works in a different way using its own language. HCI seeks to ensure maximum efficiency in getting one to talk to the other.

The design aspects of this unit should not be restricted to the traditional computer arrangement (keyboard/mouse) but should look at other devices used to input into a computer such as touch screens and voice input, and at devices other than the traditional computer system, such as mobiles and PDAs. Whilst it is appreciated that working on some of these devices may not be practical, learners can simulate many of these on the traditional PC. Specialist HCI should be discussed even where the practical aspect cannot be delivered.

Quantitative measurement of the effectiveness of an HCI can be dealt with as an extension of testing, and of the work carried out on behaviour models. The tutor can demonstrate how to approximate speed, cost and meet user need, and then learners carry out similar approximations on the work they have done or on HCIs supplied by the tutor. On a quantitative level, meeting user need does not consider the aesthetics but is done as a measure of what the user wants to achieve against what can be achieved, for example number of transactions per hour.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to the unit
<p>The impact of an HCI:</p> <ul style="list-style-type: none">• whole-class exercise – tutor presentation on the development of HCIs• individual exercise – directed research on history of HCI and developments over the years• whole-class exercise – tutor presentation on potential future developments, followed by group discussion• case studies showing needs for different HCI input and output• whole-class exercise – tutor presentation on the impact of HCI development on society, followed by group discussion• individual exercise – directed research specialist interfaces such as tactile display or speech• case studies of known impacts on society• whole-class exercise – tutor presentation on the impact of HCI development on the economy, followed by group discussion• individual exercise – directed research into impact on productivity, automation, working environments• individual exercise – calculating simple actual impact for productivity• individual exercise – simple experiments with different types of input comparing speed of each• whole-class exercise – tutor presentation on the impact of HCI development on culture, followed by group discussion• individual exercise – observation in public places• individual exercise – directed research into mobile technology, psychological impact and sociological impact.
Assignment 1 – Impact of HCI on Society, Economy and Culture
<p>Principles of interface design:</p> <ul style="list-style-type: none">• whole-class exercise – tutor presentation on perception, followed by group discussion• whole-class exercise – tutor presentation on behaviour models, followed by individual research and practical exercise• individual exercise – directed research using pre-prepared worksheets• whole-class exercise – tutor presentation on perception information processing, followed by individual research and practical exercise.

Topic and suggested assignments/activities and/assessment

HCI design:

- whole-class exercise – tutor presentation giving an overview of input HCIs
- whole-class exercise – tutor presentation on designing input via mouse and keyboard, followed by practical exercise
- whole-class exercise – tutor presentation on designing, creating and implementing input HCI from designs, followed by practical exercise
- whole-class exercise – tutor presentation on designing, creating and implementing for devices other than keyboard and mouse (eg touch screen), followed by practical exercise
- whole-class exercise – tutor presentation giving an overview of output HCIs
- whole-class exercise – tutor presentation on designing output via monitor and printer, followed by practical exercise
- whole-class exercise – tutor presentation on creating and implementing output HCIs from designs, followed by practical exercise
- whole-class exercise – tutor presentation on designing, creating and implementing for devices other than monitor and printer (eg interactive whiteboard), followed by practical exercise
- whole-class exercise – tutor presentation giving an overview of specialist HCIs
- whole-class exercise – tutor presentation on software designed for use in special circumstances, eg for the visually challenged, followed by practical exercise
- whole-class exercise – tutor presentation on processes and techniques for designing specialist HCIs, followed by practical exercise.

Assignment 2 – Understanding and Designing HCI

Test and evaluate:

- whole-class exercise – tutor presentation on simple testing, a refresher on testing as a generic feature
- individual exercise – practical testing of HCIs
- whole-class exercise – tutor presentation on quantitative measures of effectiveness, including how to:
 - ◇ calculate rough speed, costs and comparison with original need
 - ◇ quantitatively compare one HCI with another (eg own against commercial)
 - ◇ measure user satisfaction
 - ◇ qualitatively compare HCI
- individual exercise – directed study examples on the web and case studies
- whole-class exercise – tutor presentation on evaluation, including:
 - ◇ how to judge effectiveness
 - ◇ assessing potential improvements
- individual exercise – evaluating HCIs using case studies where available.

Assignment 3 – Implementing and Evaluating HCI

Assessment

It is suggested that this unit is assessed using the three assignments summarised in the *Programme of suggested assignments* table.

The numbering of the assignments does not mean that they have to be undertaken in that order.

Suggested Assignment 1 – Impact of HCI on Society, Economy and Culture

A suggested scenario is that learners work for an IT consultancy company and are required to put together a mixed media training package for new recruits on the history, development, impact and future of HCI with regard to society, the economy and culture.

(This is a suggestion only and tutors may have ideas that are more relevant to their particular learners.)

There is a wealth of material available to provide evidence for P1, including the prescriptive and indicative content of (LO1), so selecting one each for impact on society, economy and culture should not be a real problem. The learner needs to describe the impact, not necessarily the HCI involved, and needs to provide a description in their own words. A possible vehicle for this is a series of information 'leaflets' which may be paper based or digital, for example presentation, web pages. The 'leaflets', should be appropriately illustrated to enhance the text.

DI asks learners to use their imagination. What do they think might be a future development in HCI? Possibly a development of something which already exists, or something totally new. They must consider what impact, if any, the development would have on society, economy and culture. A web page could be used for this although evidence could be in almost any format.

Suggested Assignment 2 – Understanding and Designing HCI

The idea of the IT consultancy company may be extended to cover the second assignment. Having recruited new staff the consultancy like to give them practical tasks to test their knowledge and understanding of HCI principles.

The practical work starts with the design of different input and output HCI for criterion P3. At least two input and two output designs should be attempted. Providing the HCI are sufficiently dissimilar, any subjects can be selected either by the tutor or by learners. The inputs and outputs need not be related. In this instance suggestions are as follows, but anything appropriate can be used: keyboard input from data entry forms into a form designed by the learner, data entry by document reader, scanner, voice or anything else which is not a keyboard, touch screen set up with a block of products for sale, similar to concept keyboards, output from a database to screen and printer, voice output for a special needs requirement, output to an interactive whiteboard.

Evidence will be the documentation produced in designing the HCI such as story boards and flowcharts.

P2 is not practical but is closely associated with the practical work being undertaken. Learners are to explain the fundamental principles of design as defined in the unit content, ie perception, behaviour models and information processing. The evidence is an explanation of the principles, which implies both knowledge and understanding (what and why). A short presentation may be appropriate, but this criterion may be fully or partially covered by work for criterion M2.

For M2, an explanation of the fundamental principles applied to the learner's designs is required. These should be explained in relation to the designs. An annotated diagram with appended notes or a presentation may be appropriate for this.

For criterion M1, learners must provide an explanation of how the HCIs they have designed could be adapted to meet a specialist need. The tutor could supply a list of alternative specialist needs for learners to choose from. As long as the HCIs are sufficiently different the same need may be considered for more than one HCI.

Suggested Assignment 3 – Implementing and Evaluating HCI

Continuing the theme, the new consultancy recruits are now required to implement, test and document the designs.

For P4, learners will create input and output HCIs. These do not have to be those designed for P3. Although that would seem sensible, it may not be possible depending on access to the software and/or hardware required for their designs. In this case existing designs may be used. Annotated screen dumps and any associated documentation will provide evidence.

For P5, testing (as outlined in the unit content) of all the HCIs should be evidenced.

P6 requires the learner to bring together all the documentation for the design and development of the HCIs in a structured and manageable format.

M3 is about how the effectiveness of HCI in general can be measured both quantitatively and qualitatively. Learners only have to describe how this is done, they do not have to do it themselves. A written report will probably be required.

Finally, for criterion D2, the learner should produce a report evaluating each HCI, indicating good and less good points about each, and any potential improvements. Comparison with commercially produced HCIs may help with this evaluation.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, D1	Impact of HCI on Society, Economy and Culture	An IT consultancy company requires a training package for new recruits on the history, development, impact and future of HCI.	Information 'leaflets' – paper or digital Web page
P2, P3, M1, M2	Understanding and Designing HCI	An IT consultancy requires their new recruits to design a number of HCIs for specific needs to demonstrate they understand the principles of design.	Presentation Design documentation eg story board, flowchart etc Annotated/appended diagrams/charts
P4-P6, M3, D2	Implementing and Evaluating HCI	Given a series of HCI designs, the new recruits are to implement, test and document the designs.	Screen dumps Testing records Report

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC in IT sector suite. This unit has particular links with the following unit titles in the IT suite:

Level 2	Level 3	Level 4
Unit 18: Software Design	Unit 20: Client Side Customisation of Web Pages	Unit 10: Human Computer Interaction

This unit maps to some of the underpinning knowledge from the following areas of competence in the Level 3 National Occupational Standards for IT (ProCom):

- 4.6 Human Computer Interaction/Interface (HCI) Design.

Essential resources

Learners will need access to some input and output devices as detailed in the unit content, and to related software with which to create example input and output HCIs. Sufficient time to use the hardware and software must also be made available.

Employer engagement and vocational contexts

Visits to commercial and non-commercial organisations will enable learners to see a variety of input and output HCIs. It would be particularly useful if it is possible to see some of the more specialist HCIs and associated hardware (eg Braille input, tactile display output, remote materials handling, virtual reality input and output, head up displays).

Indicative reading for learners

Textbooks

Most textbooks in this subject area are aimed at level 4 and above, but the following are of interest at this level:

Carroll John M (Editor) – *HCI Models, Theories, and Frameworks: Toward a Multidisciplinary Science* (Morgan Kaufman, 2003) ISBN-10 1558608087, ISBN-13 978-1558608085

Preece J, Rogers Y and Sharp H – *Interaction Design: Beyond Human-Computer Interaction, 2nd Edition* (John Wiley and Sons Ltd, 2007) ISBN-10 0470018666, ISBN-13 978-0470018668

Websites

java.sun.com/products/jlf/ed1/dg/higa.htm

www.ilikecake.net/hci/index.htm

www.vhml.org/theses/nannip/HCI_final.htm

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	explaining how HCIs can be adjusted for specialist needs explaining how HCI effectiveness can be measured testing HCIs
Creative thinkers	designing input and output HCIs to meet given specifications evaluating future developments
Reflective learners	evaluating developed HCIs.

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Creative thinkers	describing the impact development in HCI may have on society, economy and culture.

● Functional Skills – Level 2

Skill	When learners are ...
ICT – Using ICT	
Plan solutions to complex tasks by analysing the necessary stages	creating input and output HCIs
Select, interact with and use ICT systems safely and securely for a complex task in non-routine and unfamiliar contexts	creating input and output HCIs
ICT – Finding and selecting information	
Select information from a variety of sources to meet requirements of a complex task	designing input and output HCIs
ICT – Developing, presenting and communicating information	
Use communications software to meet requirements of a complex task	creating input and output HCIs
Combine and present information in ways that are fit for purpose and audience	creating input and output HCIs
Evaluate the selection, use and effectiveness of ICT tools and facilities used to present information	evaluating input and output HCIs.