AWARD STANDARDS - **COMPUTING**

FOREWORD

The Qualifications (Education & Training) Act 1999 required the Higher Education and Training Awards Council to determine standards of knowledge, skill or competence to be acquired by learners "before a higher education and training award may be made". These standards are based on the level indicators and award-type descriptors of the National Framework of Qualifications (NFQ, Appendix 2).

Standards for certain broad fields of learning were developed for awards at level 6 to level 9 on the NFQ. These standards represent an elaboration of the generic descriptors of the Framework. They should facilitate experts in particular fields of learning to create the link between their programmes' intended learning outcomes and the NFQ. These standards are not programme specifications. It is through these, however, that the relationship between a programme, its component parts and the NFQ should be evident. The standards are a reference point and a point of comparison against which individual programmes may be justified.

They are intended to provide general guidance for articulating the learning outcomes associated with a particular field of learning. In designing programmes, providers must take cognisance of the standards for specific fields of learning where they generally relate to the programme being developed. It is, however, recognised that there is a significant growth in multi-disciplinary/inter-disciplinary programmes; there are emerging fields of learning; and in addition, within each field there is the vast spectrum of programmes possible, which range from highly practical to very theoretical.

In this context, it is not possible to have a standard, or multiple standards, that cater for the complete range of programmes possible. It is therefore expected that the standards for specific fields of learning will be used as reference points for the design of programmes.

In drafting the standards every effort has been made to ensure that they will provide for flexibility and variety in the design of programmes and therefore encourage innovation within an overall agreed framework. It is not expected that all programmes will include every learning outcome identified in a standard. It is, however, expected that many programmes will include learning outcomes that are not included in the relevant standard. When designing a programme, each learning outcome in the standard should be considered. Where departure from these is necessary, it should be justified in the context of the specific orientation of the programme and other facts pertaining to it. Each programme provider should be able to demonstrate how the design and content of its own programmes has been informed by the standard.

The level descriptors of the Framework, the award type descriptors and consequently the standards for the specific fields of learning are divided into three different types of learning outcomes - knowledge, skill and competence.

These strands are further subdivided (sub-strands). Each strand/sub-strand is important. The relative weighting of each strand in a programme will vary from programme to programme. The weighting will be determined by many factors, including for example, the practical nature of a programme, or otherwise. Each strand/sub-strand should be addressed appropriately in every programme. Where a programme is multi-disciplinary or inter-disciplinary in nature, the use of more than one standard may be necessary. In such cases, the scope, depth and balance of concepts and application should not result in the neglect of either the theoretical, or applied, at the expense of the other.

These standards were originally determined by the Higher Education and Training Awards Council in August 2005 and reissued with a new foreword by QQI in July 2014. They are QQI awards standards under section 84 (10) of the Qualifications (Education and Training) Act 2012.

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Knowledge				
	Level 6	**Level 7**	**Level 8**	**Level 9**
	The graduate should be able to demonstrate:	The graduate should be able to demonstrate:	The graduate should be able to demonstrate:	The graduate should be able to demonstrate:
Knowledge-Breadth	*Specialised knowledge of a broad area*	*Specialised knowledge across a variety of areas*	*An understanding of the theory, concepts and methods pertaining to a field (or fields) of learning*	*A systematic understanding of knowledge, at, or informed by, the forefront of a field of learning*
	The learner will have knowledge and understanding of the basic concepts in the following areas: • Computer Systems • Software Engineering • Information Systems • Mathematical Foundations and Techniques • Computing Techniques • Computer Networks • Social and Professional Issues For example: • Computer Architecture and Organisation, Basic Operating Systems • Programming Fundamentals, Systems Analysis and Design, Software Verification • Database Systems • Logic, Discrete Mathematics • Graphical User Interfaces Problem Solving • Basic Network Applications • Computing in Society	The learner will have knowledge and understanding of intermediate and some advanced concepts in the following areas: • Computer Systems • Software Engineering • Information Systems • Mathematical Foundations and Techniques • Computing Techniques • Computer Networks • Social and Professional Issues For example: • Operating Systems, Computer Architecture and Organisation • Programming Languages, Soft-ware Modelling and Analysis, Software Design • Database Systems, E-Business and E-Commerce • Statistics • Graphics and Visual Computing • Network Organisation and Management • Management	The learner will have knowledge and understanding of advanced concepts in the following areas: • Computer Systems • Software Engineering • Information Systems • Mathematical Foundations and Techniques • Computing Techniques • Computer Networks • Social and Professional Issues For example: • Distributed Systems, Real-Time Systems, Parallel Processing, Security • Software Evolution, Software Process, Software Quality, Soft-ware Validation, Software Management • Information Management • Artificial Intelligence, Human-Computer Interaction and Usability Algorithms, Web-Based Systems, Games Programming • Net-centric Computing, Mobile and Wireless Technology • Professional and Ethical Issues	The learner will have expert knowledge of one or more current, state-of-the-art specialist computing areas and will be able to demonstrate knowledge of relevant research methodologies.
Knowledge-Kind	*Some theoretical concepts and abstract thinking, with significant underpinning theory*	*Recognition of limitations of current knowledge and familiarity with sources of new knowledge; integration of concepts across a variety of areas*	*Detailed knowledge and understanding in one or more specialised areas, some of it at the current boundaries of the field(s)*	*A critical awareness of current problems and/or new insights, generally informed by the forefront of a field of learning*
	The learner will be able to: 1. explain the basic concepts and theories of the core computing area; 2. describe a range of roles and responsibilities of computing professionals; 3. describe best practices in computing.	The learner will be able to: 1. explain the concepts and theories of the core and some optional computing topics; 2. integrate concepts learned across a variety of subject areas; 3. recognise the limitations of their areas of expertise.	The learner will be able to: 1. explain concepts and theories of one or more specialist computing area, including state-of-the-art technology; 2. describe the limitations of some current computing theories and knowledge; 3. explain how academic and industrial research leads to new computing knowledge and technologies.	The learner will be able to: 1. demonstrate an awareness and critical understanding of developments in a number of specialist areas in computing; 2. discuss current challenges and research activities in at least one of these areas; 3. apply accepted methodologies for tackling research problems.

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Know-How & Skill-Range	*Demonstrate comprehensive range of specialised skills and tools*	*Demonstrate specialised technical, creative or conceptual skills and tools across an area of study*	*Demonstrate mastery of a complex and specialised area of skills and tools; use and modify advanced skills and tools to conduct closely guided research, professional or advanced technical activity*	*Demonstrate a range of standard and specialised research or equivalent tools and techniques of enquiry*
	The learner will be able to: 1. operate computing equipment and software systems effectively; 2. identify and discuss computing practices and procedures commonly found in organisations; 3. implement computer-based systems; 4. test computer-based systems; 5. identify any risks or safety issues that may be involved in the operation of computing equipment within a given context; 6. demonstrate effective information retrieval skills; 7. apply best practices in computing; 8. communicate effectively orally and in writing.	The learner will be able to: 1. implement system modelling techniques (such as entity-relationship, class and use-case modelling); 2. show proficiency in at least one programming language; 3. use numeracy skills in presenting cases involving a quantitative dimension; 4. design and implement computer-based systems; 5. deploy computer-based systems in a well-defined context; 6. apply the principles of human-computer interaction to the evaluation and construction of a wide range of materials including user interfaces, web pages and multimedia systems; 7. apply the principles of effective information management, organisation and retrieval to information of various kinds; 8. identify relevant material on a given topic from available information sources; 9. succinctly present rational and reasoned arguments to a range of audiences; 10. create effective technical documentation.	The learner will be able to: 1. model and design complex computer-based systems in a way that demonstrates comprehension of the trade-off involved in design choices; 2. deploy appropriate theory, practices and tools for the specification, design, implementation and evaluation of computer-based systems; 3. apply quality concepts to computing products and processes; 4. analyse the extent to which a computer-based system meets the criteria defined for its current use and future development; 5. conduct research in topics in computing under close supervision and guidance; 6. locate and evaluate information through online research.	The learner will be able to: 1. select and apply standard and customised research tools and techniques of enquiry forming a solid foundation for pursuing further research; 2. critically evaluate design and implementation issues in particular application areas depending on the research undertaken; 3. communicate to a range of audiences in both written and verbal media about new and emerging theories and technologies in an articulate and convincing fashion; 4. integrate advanced theoretical knowledge and solve complex problems in new, ill-defined or unfamiliar domains and/or domains at the forefront of learning; 5. critically evaluate and synthesise the academic research and professional literature base; 6. exhibit his/her research capabilities in a number of cutting-edge computing topics, demonstrating an understanding of the changing knowledge base in these topics; 7. independently acquire and assess knowledge in novel and emerging technologies.
Know-How & Skill-Selectivity	*Formulate responses to well-defined abstract problems*	*Exercise appropriate judgement in planning, design, technical and/or supervisory functions related to products, services, operations or processes*	*Exercise appropriate judgement in a number of complex planning, design, technical and/or management functions related to products, services, operations or processes, including resourcing*	*Select from complex and advanced skills across a field of learning; develop new skills to a high level, including novel and emerging techniques*
	The learner will be able to: 1. test computer-based systems; 2. interpret and produce appropriate documentation of problem resolution for further reference; 3. implement computer based systems solutions to well-defined problems; 4. make decisions justified by logical reasoning; 5. use troubleshooting strategies and techniques in correcting a variety of computer hardware and software problems.	The learner will be able to: 1. test and confirm the extent to which a computer-based system meets the criteria defined for its current use; 2. create technical documentation, locate and evaluate information through online research; 3. design and implement computer-based systems; 4. apply strategies to identify and solve computer system problems; 5. justify selections from alternatives; 6. develop innovative solutions to pragmatic situations; 7. identify and analyse criteria and specifications appropriate to specific problems and plan strategies for their solution; 8. recognise the moral and ethical issues involved in the exploitation of computer technology.	The learner will be able to: 1. evaluate computer based systems in terms of general quality attributions and possible trade-offs presented within the given problem; 2. specify, design and implement computer-based systems; 3. manage a computer-based project throughout all stages of the lifecycle; 4. identify and analyse criteria and specifications appropriate to specific problems and plan strategies for their solution; 5. identify and select appropriate strategies to solve system problems; 6. develop innovative solutions to real-life situations.	The learner will be able to: 1. independently acquire and assess knowledge in novel and emerging technologies; 2. integrate knowledge of various technologies and computing principles to successfully plan and develop a computer-based project; 3. apply existing and develop new research skills to plan and implement a research project to solve a challenging computing problem; 4. formulate judgements and synthesise conclusions following the completion of a systematic piece of research 5. select and apply standard and customised research tools and techniques of enquiry forming a solid foundation for pursuing further research.

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Competence-Context	*Act in a range of varied and specific contexts involving creative and nonroutine activities; transfer and apply theoretical concepts and/or technical or creative skills to a range of contexts*	*Utilise diagnostic and creative skills in a range of functions in a wide variety of contexts*	*Use advanced skills to conduct research, or advanced technical or professional activity, accepting accountability for all related decision making; transfer and apply diagnostic and creative skills in a range of contexts*	*Act in a wide and often unpredictable variety of professional levels and illdefined contexts*
	The learner will be able to: 1. work in a safe and ethical manner; 2. recognise and apply common best practices; 3. demonstrate awareness of ethical and legal practices in the exploitation of computer technology; 4. recognise common solutions to a range of problems; 5. recognise common diagnostic techniques; 6. demonstrate awareness of new technologies.	The learner will be able to: 1. recognise risks or safety aspects relevant to computing systems within a given context; 2. recognise the best practices relevant to a range of real-world contexts; 3. recognise ethical and legal practices in the exploitation of computer technology; 4. recognise the suitability of a given solution to a problem; 5. recognise the suitability of a given diagnostic technique in a context; 6. describe the impact of new technologies in a given environment.	The learner will be able to: 1. select and implement measures to address identified risks or safety aspects relevant to computing systems within a given context; 2. apply best practice in a range of real-world contexts; 3. adopt appropriate professional, ethical and legal practices in the exploitation of computer technology; 4. act effectively and choose an appropriate response from a range of possibilities; 5. transfer and apply creative and diagnostic skills in a range of contexts; 6. assess the impact of new technologies in a given environment.	The learner will be able to: 1. analyse and document measures to address risks or safety aspects relevant to computing systems within a given context; 2. evaluate existing and develop new best practices in a range of real-world contexts; 3. develop guidelines regarding professional, ethical and legal practices in the exploitation of computer technology; 4. design and implement a computing solution that requires significant preliminary research for novel and unfamiliar situations; 5. evaluate existing and develop new diagnostic models in a range of contexts; 6. identify potential projects and research opportunities; 7. conduct appropriate research and undertake the design and development of computing solutions; 8. demonstrate an appreciation of the professional standards relevant to the computing discipline.
Competence-Role	*Exercise substantial personal autonomy and often take responsibility for the work of others and/or for allocation of resources; form, and function within, multiple complex and heterogeneous groups*	*Accept accountability for determining and achieving personal and/or group outcomes; take significant or supervisory responsibility for the work of others in defined areas of work*	*Act effectively under guidance in a peer relationship with qualified practitioners; lead multiple, complex and heterogeneous groups*	*Take significant responsibility for the work of individuals and groups; lead and initiate activity*
	The learner will be able to: 1. apply knowledge in a practical setting under supervision; 2. interact effectively with others,including non-computing staff.	The learner will be able to: 1. work effectively as a member of an interdisciplinary team; 2. interact effectively with a range of staff at different levels in an organisation; 3. plan and organise work; 4. monitor project work against a plan.	The learner will be able to: 1. work effectively as an autonomous individual; 2. manage issues involved in leading complex groups; 3. work as a member of a development team, recognising the different roles within a team and different ways of organising teams; 4. interact effectively with staff at all levels of an organisation; 5. work in an international context; 6. design and manage small group projects; 7. constructively criticise the work of others.	The learner will be able to: 1. initiate, lead and manage projects of significant complexity involving multi.disciplinary teams; 2. work as a member of an IT strategic planning team; 3. participate in peer collaboration and evaluation exercises.

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Competence-Learning to Learn	*Learn to evaluate own learning and identify needs within a structured learning environment; assist others in identifying learning needs*	*Take initiative to identify and address learning needs and interact effectively in a learning group*	*Learn to act in variable and unfamiliar learning contexts; learn to manage learning tasks independently, professionally and ethically*	*Learn to self-evaluate and take responsibility for continuing academic/professional development*
	The learner will be able to: 1. demonstrate the capacity to learn new knowledge and skills; 2. appreciate the need for continuing professional development in recognition of the need for lifelong learning; 3. participate in group learning activities.	The learner will be able to: 1. generate new ideas; 2. apply knowledge learned in new situations; 3. design and manage personal projects.	The learner will be able to: 1. select and apply appropriate research skills; 2. evaluate own strengths and weaknesses; 3. identify limitations of own knowledge; 4. constructively criticise own work; 5. manage one's own learning and development, including time management and organisational skills; 6. apply quality concepts to products and processes of own work.	The learner will be able to: 1. reflect on the strengths, weaknesses and potential for future development of his/her own work; 2. demonstrate an understanding of the importance of continuing personal development in the computing discipline and the mechanisms and resources available to support that learning.
Competence-Insight	*Express an internalised, personal world view, reflecting engagement with others*	*Express an internalised, personal world view, manifesting solidarity with others*	*Express a comprehensive, internalised, personal world view, manifesting solidarity with others*	*Scrutinise and reflect on social norms and relationships and act to change them*
	The learner will be able to: 1. recognise group dynamics and respond appropriately; 2. accept constructive criticism and use that feedback constructively.	The learner will be able to: 1. describe some of the wider social and business contexts within which computing professionals operate; 2. describe the benefits of diversity in teams.	The learner will be able to: 1. identify and appropriately address ethical issues; 2. describe examples and benefits of diversity and multiculturalism; 3. describe and adapt inter-personal interactions based on knowledge of the cultures and customs of other countries.	The learner will be able to: 1. critically comment on the technical and social implications of his/her own work and the work of others; 2. demonstrate a critical appreciation of the design issues in developing a computing system, taking into account the environment in which it is used; 3. evaluate the way that computing technology is currently affecting society and reflect on its potential future effect; 4. maintain integrity and independence in professional judgement.

APPENDIX 1

National Framework of Qualifications - Grid of Level Indicators

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	Level 9	Level 10
Knowledge - Breadth	Elementary knowledge	Knowledge that is narrow in range	Knowledge moderately broad in range	Broad range of knowledge	Broad range of knowledge	Specialised knowledge of a broad area	Specialised knowledge across a variety of areas	An understanding of the theory, concepts and methods pertaining to a field (or fields) of learning	A systematic understanding of knowledge, at, or informed by, the forefront of a field of learning	A systematic acquisition and understanding of a substantial body of knowledge which is at the forefront of a field of learning
Knowledge -Kind	Demonstrable by recognition or recall	Concrete in reference and basic in comprehension	Mainly concrete in reference and with some comprehension of relationship between knowledge elements	Mainly concrete in reference and with some elements of abstraction or theory	Some theoretical concepts and abstract thinking, with significant depth in some areas	Some theoretical concepts and abstract thinking, with significant underpinning theory	Recognition of limitations of current knowledge and familiarity with sources of new knowledge; integration of concepts across a variety of areas	Detailed knowledge and understanding in one or more specialised areas, some of it at the current boundaries of the field(s)	A critical awareness of current problems and/or new insights, generally informed by the forefront of a field of learning	The creation and interpretation of new knowledge, through original research, or other advanced scholarship, of a quality to satisfy review by peers
Know-how and skill – Range	Demonstrate basic practical skills, and carry out directed activity using basic tools	Demonstrate limited range of basic practical skills, including the use of relevant tools	Demonstrate a limited range of practical and cognitive skills and tools	Demonstrate a moderate range of practical and cognitive skills and tools	Demonstrate a broad range of specialised skills and tools	Demonstrate comprehensive range of specialised skills and tools	Demonstrate specialised technical, creative or conceptual skills and tools across an area of study	Demonstrate mastery of a complex and specialised area of skills and tools; use and modify advanced skills and tools to conduct closely guided research, professional or advanced technical activity	Demonstrate a range of standard and specialised research or equivalent tools and techniques of enquiry	Demonstrate a significant range of the principal skills, techniques, tools, practices and/or materials which are associated with a field of learning; develop new skills, techniques, tools, practices and/or materials
Know-how and skill – Selectivity	Perform processes that are repetitive and predictable	Perform a sequence of routine tasks given clear direction	Select from a limited range of varied procedures and apply known solutions to a limited range of predictable problems	Select from a range of procedures and apply known solutions to a variety of predictable problems	Evaluate and use information to plan and develop investigative strategies and to determine solutions to varied unfamiliar problems	Formulate responses to well-defined abstract problems	Exercise appropriate judgement in planning, design, technical and/or supervisory functions related to products, services, operations or processes	Exercise appropriate judgement in a number of complex planning, design, technical and/or management functions related to products, services, operations or processes, including resourcing	Select from complex and advanced skills across a field of learning; develop new skills to a high level, including novel and emerging techniques	Respond to abstract problems that expand and redefine existing procedural knowledge
Competence - Context	Act in closely defined and highly structured contexts	Act in a limited range of predictable and structured contexts	Act within a limited range of contexts	Act in familiar and unfamiliar contexts	Act in a range of varied and specific contexts, taking responsibility for the nature and quality of outputs; identify and apply skill and knowledge to a wide variety of contexts	Act in a range of varied and specific contexts involving creative and non-routine activities; transfer and apply theoretical concepts and/or technical or creative skills to a range of contexts	Utilise diagnostic and creative skills in a range of functions in a wide variety of contexts	display mastery Use advanced skills to conduct research, or advanced technical or professional activity, accepting accountability for all related decision making; transfer and apply diagnostic and creative skills in a range of contexts	Act in a wide and often unpredictable variety of professional levels and ill defined contexts	Exercise personal responsibility and largely autonomous initiative in complex and unpredictable situations, in professional or equivalent contexts
Competence – Role	Act in a limited range of roles	Act in a range of roles under direction	Act under direction with limited autonomy; function within familiar, homogeneous groups	Act with considerable amount of responsibility and autonomy	Exercise some initiative and independence in carrying out defined activities; join and function within multiple, complex and heterogeneous groups	Exercise substantial personal autonomy and often take responsiblity for the work of others and/or for the allocation of resources; form, and function within, multiple, complex and heterogeneous groups	Accept accountability for determining and achieving personal and/or group outcomes; take significant or supervisory responsibility for the work of others in defined areas of work	Act effectively under guidance in a peer relationship with qualified practitioners; lead multiple, complex and heterogeneous groups	Take significant responsibility for the work of individuals and groups; lead and initiate activity	Communicate results of research and innovation to peers; engage in critical dialogue; lead and originate complex social processes
Competence – Learning to Learn	Learn to sequence learning tasks; learn to access and use a range of learning resources	Learn to learn in a disciplined manner in a well-structured and supervised environment	Learn to learn within a managed environment	Learn to take responsibility for own learning within a supervised environment	Learn to take responsibility for own learning within a managed environment	Learn to evaluate own learning and identify needs within a structured learning environment; assist others in identifying learning needs	Take initiative to identify and address learning needs and interact effectively in a learning group	Learn to act in variable and unfamiliar learning contexts; learn to manage learning tasks independently, professionally and ethically	Learn to self-evaluate and take responsibility for continuing academic/professional development	Learn to critique the broader implications of applying knowledge to particular contexts
Competence – Insight	Begin to demonstrate awareness of independent role for self	Demonstrate awareness of independent role for self	Assume limited responsibility for consistency of self-understanding and behaviour	Assume partial responsibility for consistency of self-understanding and behaviour	Assume full responsibility for consistency of self-understanding and behaviour	Express an internalised, personal world view, reflecting engagement with others	Express an internalised, personal world view, manifesting solidarity with others	Express a comprehensive, internalised, personal world view manifesting solidarity with others	Scrutinise and reflect on social norms and relationships and act to change them	Scrutinise and reflect on social norms and relationships and lead action to change them

Note: The outcomes at each level include those of all the lower levels in the same sub-strand