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A Generic Integrated and Interactive Framework (GIIF) for developing information literacy skills in higher education

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Introduction and Rationale

Information literacy (IL) is defined as “the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and participating ethically in communities of learning” (ACRL 2015, p.3). The term IL was originally confined to library and IT skills (Behrens, 1994; Johnston & Webber, 2003) but has since received increasing international interest. It is considered as an important 21st century skill in combination with critical thinking (Kong, 2014), and is perceived as basic human right within the digital world (UNESCO, 2008). The importance of IL within the contemporary information society has been acknowledged due to its relevance to lifelong learning (Bruce, 1999; Johnston & Webber, 2003; Podgornik, Dolničar, Šorgo, & Bartol, 2016). Appendix A.1 contains a review of evolving definitions.

The IL competency of higher education students is significantly increased by the integration of IL elements in the classroom (e.g. Cochrane, 2006; Kennedy & Monty, 2008; Price, Becker, Clark & Collins, 2011; Kong 2014; Sandercock 2016). However, IL skills of students are often limited to beginner levels (Henkel, Grafmüller, & Gros 2018). The U.S. Association of College and Research Libraries (ACRL) argues that in the contemporary information society, students are invariably expected to create new knowledge by understanding and using (ethically) ever-evolving sources of information. Teachers should design “curricula and assignments that foster enhanced engagement with the core ideas about information and scholarship within their disciplines”, and librarians should collaborate extensively with teachers to facilitate the development of an integrated curriculum for IL (ACRL 2015, p.2). Faculty and librarians need to develop a shared understanding of the IL skills and competencies graduates should possess (Sandercock, 2016).

In Ireland, the Working Group on Information Literacy (WGIL) was set up to focus on collaborative ways in which IL education can be further developed (O’Brien & Russell, 2012). Thus in this context (and driven by the calls for the development of integrated curricula for IL) we attempt to develop a Generic, Integrated and Interactive Framework (GIIF) for developing IL skills in higher education, with learning and teaching methods informed by the principles of gamification. The following research objectives were identified:

1. Review the state of the art for IL and IL skills frameworks
2. Embed educational dimensions and interactive activities in an integrated framework
3. Propose implementation practices of the proposed framework
4. Propose evaluation strategies for the framework.

The proposed GIFF will strengthen the IL skills of DIT graduates, develop their disciplinary expertise and judgment and facilitate them in advancing existing knowledge through innovation (aligned with the Graduate attributes described in Appendix A.5).

Literature Review

GIIF is based on a review of existing best practices briefly summarised in the following paragraphs.

A review of IL frameworks

The Australian and New Zealand Information Literacy Framework (ANZIL) standards (endorsed by the Consortium of National and University Libraries (CONUL)) are intended to inform a curriculum whereby IL learning outcomes, assessments and delivery are constructively aligned (Bundy, 2004). They are based on four overarching principles and six core standards outlined in Appendix A.2. The standards are expressed as a set of statements defining the activities and behaviour of the information literate person and as such can be embedded into the learning outcomes of existing modules. IL is acknowledged as a subset of independent learning, which in turn is a subset of lifelong learning.

The SCONUL model outlines 7 pillars that define an information literate person (Appendix A.2) (Bent & Stubbings, 2011). Within the model each pillar is related to a set of competencies and attitudes/understandings (Bent & Stubbings, 2011). The Scottish information literacy project (SILIP) used the existing Scottish Qualification Authority (SQA) core skills framework, the SCONUL seven pillars model, and the IL skills as defined by CILIP (The Scottish Information literacy project, nd). See Appendix A2.

Secker & Coonan (2011) developed a new curriculum for information literacy (ANCIL) consisting of ten thematic strands which fall into five broad learning categories (Secker & Coonan, 2012) (Appendix A.2). Secker & Coonan (2011) outline that the aim for IL is that undergraduate learners develop a high-level, reflective understanding of information contexts so that they can evaluate, analyse and assimilate information through their skill set, an aim that is clearly linked to reaching higher orders of Bloom's taxonomy (Bloom, Engelhart, Hill, Furst, & Krathwhol, 1956). They consider that IL should not be a library owned product and should be embedded in the academic curriculum. Their assertion that students should view IL as a coherent whole is well founded and appropriate taught modules in which to embed activities that promote the desired IL skills should be identified (Karnad, 2013).

Framework implementation examples

Induction sessions provided at the start of the academic year are not effective for developing IL and it is better broken down into individual, successive components so that students can progressively advance their skills (Bell, Moon, & Secker, 2012; Secker & Coonan, 2011). Who the change agent is, is a key consideration and lecturers must support implementation. Several case studies from the London School of Economics illustrate a model whereby an academic support librarian delivers a series of workshops on academic writing, literature searching and using databases across several core modules (Bell et al., 2012). The CASCADE project worked with a combination of postgraduate's and faculty to develop their use of digital technologies (Karnad, 2013). They created an interactive map of Bloom's taxonomy

that links an outcome type to a digital activity (University of Exeter, 2011b) (Appendix A.2). Maynooth University have based their IL framework on ANCIL (Secker & Coonan, 2011) and ACRL (ACRL, 2015) (Appendix A.2). The resulting framework is founded on the idea that IL skills should be embedded in module content.

The use of serious games and interactive technology for IL teaching and learning

Practical skill development for future careers requires innovative, blended learning techniques (Abykanova, Nugumanova, Yelezhanova, Kabylkhamit, & Sabirova, 2016). In light of their daily use of technology, the current generation call for interactive, visual and problem-based approaches (Pasin & Giroux, 2011). Simulation tools (which help to develop analytical and problem-solving skills) assist in the explanation of complex subjects and there exists wide scope for their use to aid IL skill development. Successful adoption for simulation is highlighted in health (Wattanasoontorn, Boada, García, & Sbert, 2013), engineering (Koltai, Lozano, Uzonyi-Kecskés, & Moreno, 2017; Ross, Fitzgerald, & Rhodes, 2014), medical (Khalaila, 2014), and economics (van Wyk, 2013).

Serious games use characteristics of video/computer games to create immersive and engaging learning experiences (Freitas & Neumann, 2009). The aim is to improve learner's ability to identify and combine various sources of information to create solutions and evaluate their impact on the game flows (Bu & Mitchell, 2009). Players can practice at their own individual rate, use peer-learning, examine scenarios and make errors in a low-stakes environment while receiving feedback (Fleming, Bavin, & Stasiak, 2017). For a serious games framework to be effective, there should be integration between educational and entertainment dimensions (Aleven, Myers, Easterday, & Ogan, 2010). The educational component specifies learning objectives (Dillenbourg & Jermann, 2010) while the entertainment component determines what gaming elements will be used and their connection to the learning elements (Schell, 2011). Serious games are considered to be an efficient learning tool within the proposed framework.

Studies have shown positive response to interactive and game-like tutorials in IL teaching (Armstrong & Georgas, 2006). For example BiblioBouts games have helped students practice library searches (Markey, Leeder, & Young Rieh, 2012). A web-based IL quiz was used in classroom to encourage students to evaluate information about scholarly topics (Markey, Swanson, et al., 2012). Quality Counts game was used to improve students' skills in finding and evaluating information on the Internet (Smale, 2012).

Entertainment and challenge were discussed by Gumulak and Webber (2011) as a motivation to play the games. This study successfully mapped the SCONUL model to the game elements (Table 2). Arnab et al (n.d.) successfully mapped the game mechanism to Bloom's learning framework (Table 3). While Wang, Li, & Tzeng (2015) proposed the KCR framework to use the game elements such as tools, goals, and feedback to realise the 2D Bloom's model modified by Anderson et al. (2001) (Figure 1). Game elements help in achieving a higher order cognitive process. These studies were considered in embedding gamification in our proposed framework.

Table 2 Source SCONUL, 1999

Pillar	Examples
Recognising the information need	Needing information that would enable you to get “unstuck”. Needing information on a new game, to decide whether to purchase it
Identifying the gap between what is known and what is needed	Reviewing and revisiting within the game, to identify what information is known, and what is not known
Constructing strategies for acquiring the needed information	Deciding whether to go for the easy option (e.g. a walkthrough) or for sources, which are going to give you hints or advice, rather than the solution (e.g. a family member)
Locating and accessing information	Searching for a walkthrough, reviews, etc. Asking an experienced gamer for help
Evaluating information	Comparing information about a game, from different sources
Using and communicating information (with awareness of ethical and legal aspects)	Applying the information to the problem: getting “unstuck” and completing the game. Giving advice to fellow gamers
Synthesising and creating new knowledge	Writing game reviews. Creating material within the game (e.g. a new song on <i>Guitar Hero</i>)

Table 3 Source (Arnab et al., n.d.)

GAME MECHANICS	THINKING SKILLS	LEARNING MECHANICS	LOTS to HOTS
<ul style="list-style-type: none"> ○ Design/Editing ○ Infinite Game play ○ Ownership ○ Protégé Effect ○ Status ○ Strategy/Planning ○ Tiles/Grids 	CREATING	<ul style="list-style-type: none"> ○ Accountability ○ Ownership ○ Planning ○ Responsibility 	
<ul style="list-style-type: none"> ○ Action Points ○ Assessment ○ Collaboration ○ Communal Discovery ○ Resource Management ○ Game Turns ○ Pareto Optimal ○ Rewards/Penalties ○ Urgent Optimism 	EVALUATING	<ul style="list-style-type: none"> ○ Assessment ○ Collaboration ○ Hypothesis ○ Incentive ○ Motivation ○ Reflect/Discuss 	
<ul style="list-style-type: none"> ○ Feedback ○ Meta-game ○ Realism 	ANALYSING	<ul style="list-style-type: none"> ○ Analyse ○ Experimentation ○ Feedback ○ Identify ○ Observation ○ Shadowing 	
<ul style="list-style-type: none"> ○ Capture/Elimination ○ Competition ○ Cooperation ○ Movement ○ Progression ○ Selecting/Collecting ○ Simulate/Response ○ Time Pressure 	APPLYING	<ul style="list-style-type: none"> ○ Action/Task ○ Competition ○ Cooperation ○ Demonstration ○ Imitation ○ Simulation 	
<ul style="list-style-type: none"> ○ Appointment ○ Cascading Information ○ Questions And Answers ○ Role-play ○ Tutorial 	UNDERSTANDING	<ul style="list-style-type: none"> ○ Objectify ○ Participation ○ Question And Answers ○ Tutorial 	
<ul style="list-style-type: none"> ○ Cut scenes/Story ○ Tokens ○ Virality ○ Behavioural Momentum ○ Pavlovian Interactions ○ Goods/Information 	RETENTION	<ul style="list-style-type: none"> ○ Discover ○ Explore ○ Generalisation ○ Guidance ○ Instruction ○ Repetition 	

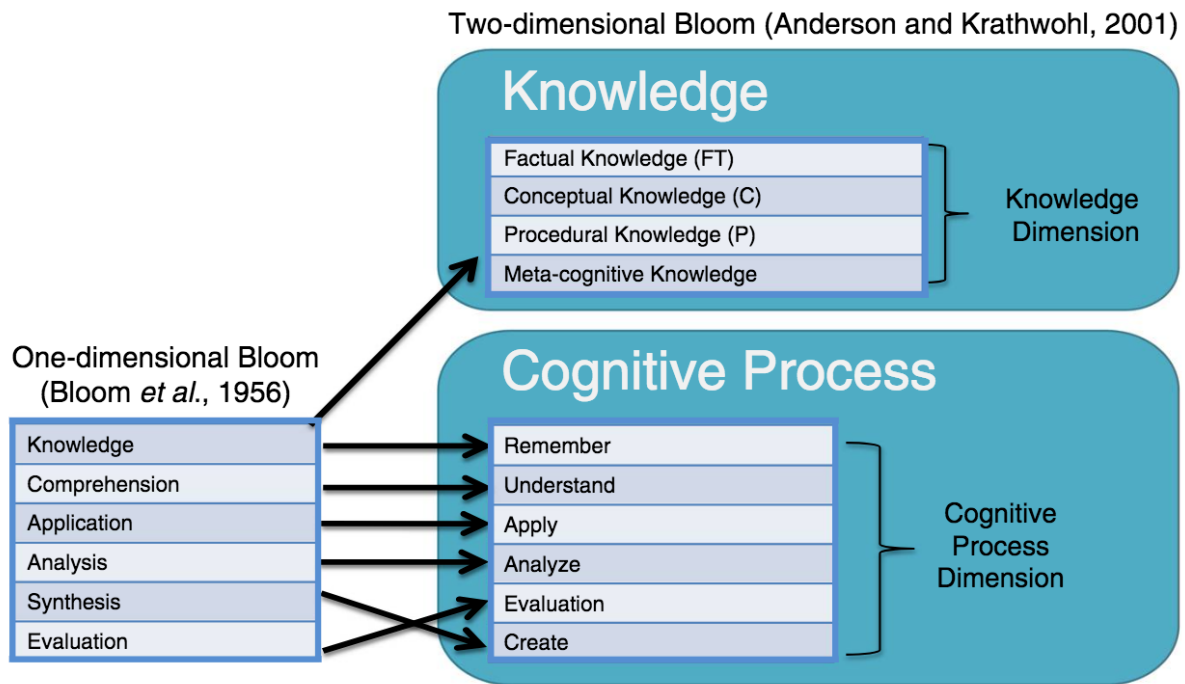


Figure 1 Source: Anderson and Krathwohl (2001)

The Framework Design and Implementation

Serious games as learning, teaching and assessment methods for IL: GILF proposed constructive alignment

To improve the efficacy of strategies and pedagogies for IL teaching and learning the framework proposes to draw upon game-based learning to achieve learning outcomes and increase student engagement and motivation. Game-based instruction can take many forms: table-top exercises (card games), on-line games, adapted existing games or designing class sessions using gaming principles (gamification). The ultimate goal is to create opportunities for students to meaningfully engage with classmates and instructors, to participate in student-centred activities and to build on their pre-existing knowledge base (Angell & Tewell 2015).

In our approach we embedded the serious games as teaching, learning and assessment methods aligned with the learning outcomes. We have adapted the ANCIL framework which proposes ten intertwined thematic strands covering the facets comprised in IL (Secker & Coonan, 2012) that also underpin some of the DIT graduate attributes:

- Strand 1 Transition from school to higher education
- Strand 2 Becoming an independent learner
- Strand 3 Developing academic literacies
- Strand 4 Mapping and evaluating the information landscape
- Strand 5 Resource discovery in your discipline
- Strand 6 Managing information
- Strand 7 Ethical dimension of information
- Strand 8 Presenting and communicating knowledge
- Strand 9 Synthesising information and creating new knowledge
- Strand 10 Social dimension of information.

Figure 2: ANCIL Framework Strands (Secker & Coonan, 2012)

In our adaptation we have aligned learning outcomes from each strand with Bloom's taxonomy and then, to possible activities suggested as serious games (following the review outlined in the previous section). Assessment was also considered and the resulting constructive alignment table for the framework is reported in Appendix A.3.

IL assessment for the framework

While considerable literature focuses on defining and characterising IL, the same wealth on the evaluation of IL is not present (Scharf, Elliot, Huey, Briller & Joshi, 2007). Standardized multiple-choice tests are a predominant means of assessment but they are not well-suited to the task of evaluating higher-order skills (Walsh 2009). As of yet there is no consensus on how the measurement of this multifaceted concept should be approached (Rosman, Mayer & Krampen 2015).

Three conceptions of IL assessment can be identified: achievement tests (multiple choice pre-test/post-test), information search tasks (open-ended questions completed using common search tools/engines) and self-assessments (Rosman, Mayer & Krampen 2015). An example of a search task is: find all meta-analyses published after 2006 investigating "risk factors" for the development of a "Post-traumatic stress disorder" (Leichner, Peter, Mayer, & Krampen, 2014). Such tasks are suitable for evaluation of appropriate information retrieval, identification and evaluation. Self-assessment methods empower students to reflect on their abilities and strategies, and to monitor their learning progress (Boud 1995). Vygotsky (1962) suggests that self-assessment can have the effect of increasing a conscious control over learning and the metacognitive awareness of own knowledge and thought.

Our intention is to use a combination of achievement tests and self-assessment to assess the students pre and post the interactive learning as a way of achieving assessment for learning and assessment for validation (Black & Wiliam, 1998).

Framework Description

GIF integrates various components to achieve the IL learning outcomes and skills development required in higher education students. As depicted in Figure 3, the adapted learning outcomes from ANCIL framework are mapped to the cognitive dimension of the 2D modified Bloom's taxonomy (realised through the game elements, goals, tools, and feedback). During the playing process, students will construct the required knowledge, which is the second dimension of the 2D Bloom's framework. Game elements also help students to engage and evaluate existing knowledge, being consistent with DITs graduate attributes (see Appendix A.5).

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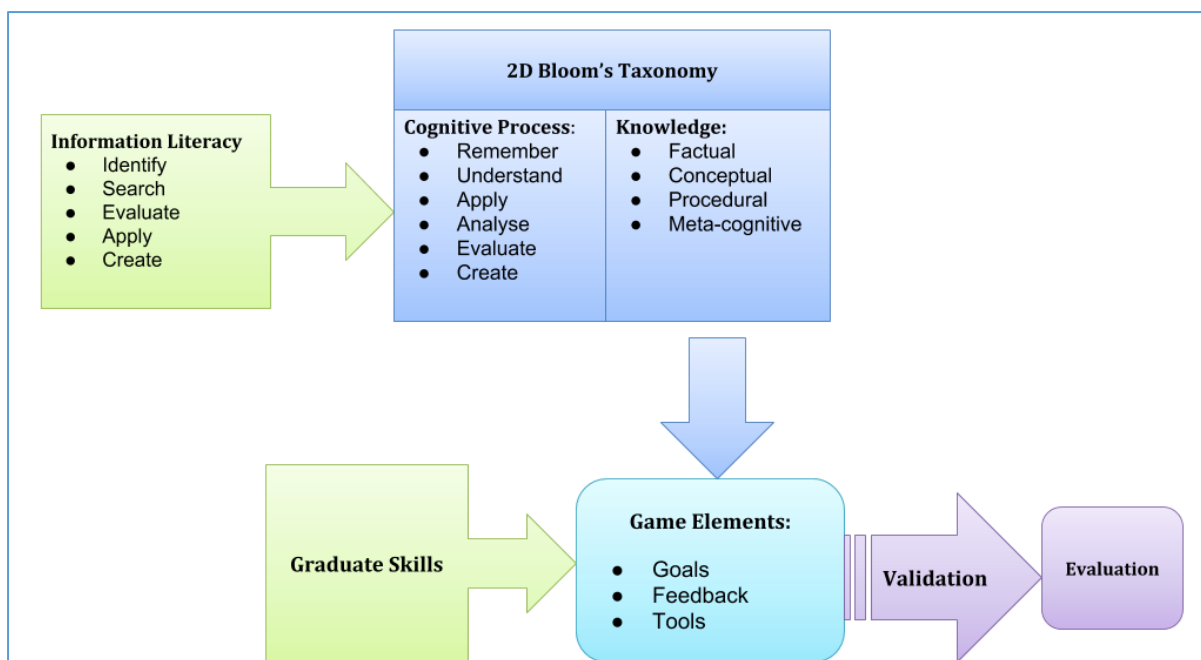


Figure 3 The GIFF

Artefact (web page)

The designed poster for GIFF is available at the following link:

<https://informationliteracyframeworkgiif.weebly.com/>

Way forward

Implementation strategy

To implement GIFF effectively, it is necessary that educational goals align with the development of the curriculum and that academics and librarians in DIT foster understanding and acceptance of IL education (Bundy, 2004). Any new IL framework must account for the multicultural setting in which modern third level education finds itself (Hicks & Lloyd, 2016).

It is clear from the literature that IL is not a standalone part of the curriculum, rather it should be part of a bigger academic skills agenda (CONUL, nd; Howard, 2012). While providing IL training as an optional workshop that only students who need the training are required to attend may seem desirable, it is often the case that undergraduates will not seek out such support and will not attend unless there is formative assessment of some sort (Bell et al., 2012). This was also found by Hegarty and Carbery (2010) who implemented a pilot IL programme for nursing students in WIT but reported low attendance in non-compulsory classes. A sequential development of IL skills is best achieved within a discipline specific context and a good starting point for integrating IL into the curriculum is by mapping IL skills over an entire programme (CONUL, nd).

A previous initiative in DIT, Get Smart, recommended embedding IL skills into all first-year modules (O'Rawe, 2011). The initiative developed and delivered three IL sessions for first year students connected to two academic modules (O'Rawe, 2011). IL learning outcomes should

be included in assessment criteria for certain activities so that students can clearly see what is required of them and be more likely to attend workshops provided (CONUL, nd).

There must be constructive alignment of the curriculum, its intended outcomes, assessment teaching and learning activities (Biggs, 1996). Gamification allows us to embed simple rubrics such as “Use of Information” or “Critical evaluation of literature” to assess various areas of IL. It also aligns closely with teaching strategies such as problem-based learning (PBL) whereby students are required to source their own information to complete a task (Dodd, 2007). As part of this research, an amended set of learning outcomes has been developed for module TFME3002 in which IL is embedded (Appendix A.4). The activities proposed in GIIF could be delivered as a joint effort between librarians and academic staff.

Evaluation strategy

Angell and Tewell (2015) assessed whether introduction of games into undergraduate IL instruction increased retention of course content for the students. Participants were divided into two groups (with and without use of serious games for IL instruction). Results revealed a statistically significant difference between scores on pre-tests and post-tests for the experimental (serious games) condition, but no significant difference was present for the control group. We envisage evaluating GIIF in a similar way following implementation but also integrating the use of qualitative data from self-assessment and feedback surveys (Newton 1998; Harvey 1998). Testing should verify students’ awareness of needs for IL, provide feedback on learning and teaching methods and assessment for learning/validation (Black & Wiliam, 1998).

Conclusions and future research

In summary, the framework proposed will require further development with regards to embedding learning outcomes into existing programs. It must be implemented as joint effort between programme chairs, lecturers and librarians in DIT and must be part of a bigger academic skills agenda brought about through student engagement (CONUL, nd; Howard, 2012). Serious games approaches were selected as a useful means to deliver teaching, learning and assessment in this area-taking note of the current generation’s use of technology. The GIIF framework will be further developed into a website providing an interactive map of Bloom’s taxonomy that links each desired learning outcome to suggested serious games/ or interactive digital activities that can be easily implanted in the classroom.

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Appendices

A1. A review of emerging and evolving definitions of information literacy

A2. Summary of existing models and frameworks for IL

A3. Constructive alignment for adapted learning outcomes in the proposed framework

A4. Example of amended module descriptor incorporating IL

A5. Graduate attributes

A1. A review of emerging and evolving definitions of information literacy

IL Definition	Source
To be information literate requires a new set of skills. These include how to locate and use information needed for problem-solving and decision-making efficiently and effectively.	(Burchinal 1976, as cited in Behren 1994)
To be information literate, a person must be able to recognise when information is needed and have the ability to locate, evaluate, and use effectively the needed information.	American Library Association (ALA) Presidential Committee on Information Literacy (1989, p.1)
IL is the ability to recognise information needs and to identify, evaluate and use information effectively.	(Bruce 1999)
Information literacy is the adoption of appropriate information behaviour to obtain, through whatever channel or medium, information well fitted to information needs, together with critical awareness of the importance of wise and ethical use of information in society.	(Johnston & Webber 2003, p.336)
IL is an umbrella term which encompasses concepts such as digital, visual and media literacies, academic literacy, information handling, information skills, data curation and data management. Information literate people will demonstrate an awareness of how they gather, use, manage, synthesise and create information and data in an ethical manner and will have the information skills to do so effectively.	(SCONUL 2011)
Information literacy (IL) refers to the mastery of necessary knowledge of gathering, synthesizing, analysing, interpreting and evaluating information; and the proper attitudes for information processing with an understanding of the rationale behind using information	Kong 2014 based on (Kong,2007; Price, Becker, Clark, & Collins, 2011)

A2 Summary of existing models and frameworks for IL

ANZIL

Overarching principles are that information literate people:			
<p>engage in independent learning through constructing new meaning, understanding and knowledge</p>	<p>derive satisfaction and personal fulfillment from using information wisely</p>	<p>individually and collectively search for and use information for decision making and problem solving in order to address personal, professional and societal issues</p>	<p>demonstrate social responsibility through a commitment to lifelong learning and community participation</p>

Figure 1 ANZIL overarching principles adapted from (Bundy, 2004)

Core standards	recognises the need for information and determines the nature and extent of the information needed
	Finds needed information effectively and efficiently
	critically evaluates information and the information seeking process
	manages information collected or generated
	applies prior and new information to construct new concepts or create new understandings
	uses information with understanding and acknowledges cultural, ethical, economic, legal, and social issues surrounding the use of information

Figure 2 ANZIL Core Standards adapted from Bundy, 2004

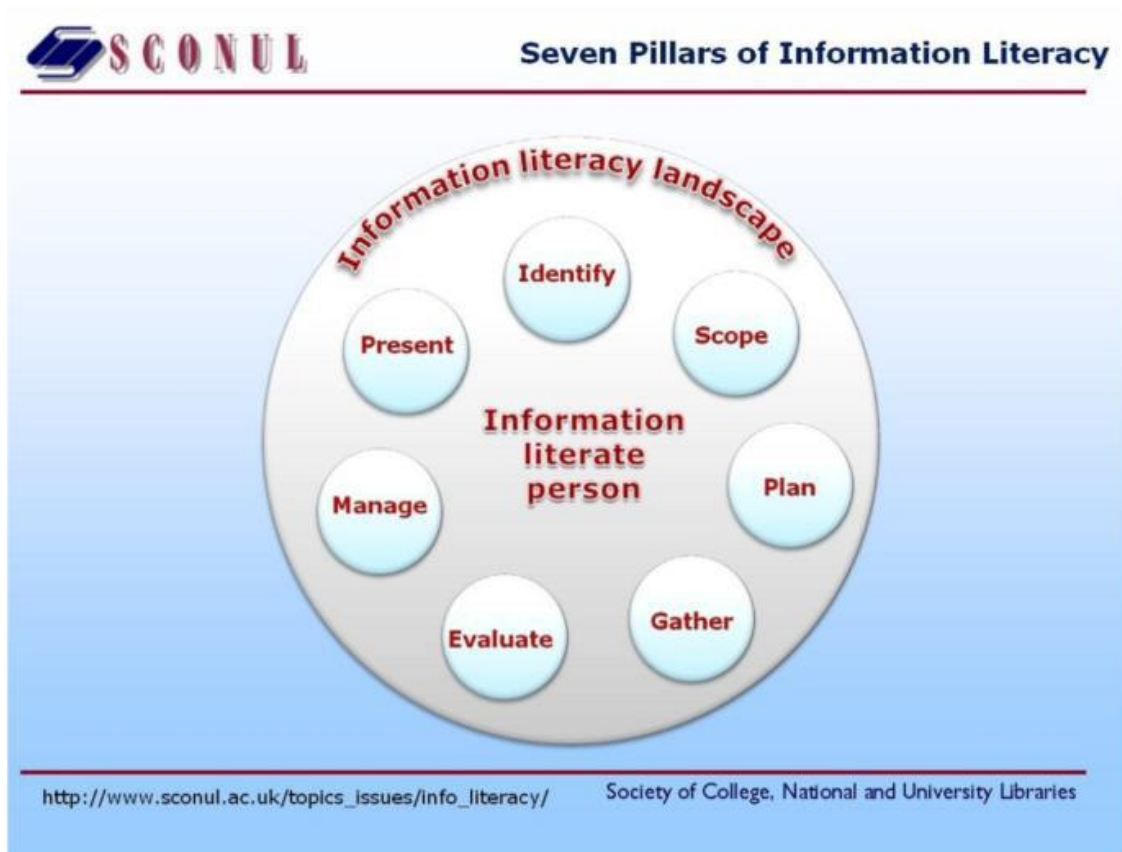


Figure 3 SCONUL Seven pillars of information literacy (Bent & Stubbings, 2011)

Identify	Scope	Plan	Gather	Evaluate	Manage	Present
Understands: The concept of digital literacy within an educational setting The Internet is not regulated but content may be structured and regulated in a variety of ways depending on the requirements of the provider Technology is constantly evolving and the exploration and evaluation of new and emerging information systems is a lifelong process The lifecycle of digital content, including issues around provenance, sharing and long-term access and preservation The benefits and limitations of using different forms of digital content, tools and technologies to meet specific needs	Understands: Issues around copyright, IPR and CC licences in relation to the use and creation of digital material The need to address issues of accessibility relating to digital content The characteristics of different digital publication formats, the functionality available within software platforms and the benefits and limitations of these in relation to the task The impact of online collaboration and networking as a means of developing, exchanging and communicating information	Understands: How to search for digital content using appropriate tools and techniques The differences between search tools (operating within and between environments), recognising their benefits and limitations The impact of sharing digital content How the use of different online communication tools can extend reach and enable teamwork and collaboration Where to locate and publish digital content for formal publication purposes and for information exchange purposes, appreciating the differences between the two	Understands: The range of different forms of digital publication and media, the different audiences they are designed for and how they are organised Issues around the popularity of a resource versus its academic quality How digital technologies are providing collaborative tools to create and share knowledge and the implications this has on gathering specific information. The risks of operating in a virtual world and how they can be mitigated The importance of appraising and evaluating results of online searches	Understands: The need to make choices in the use of different technologies to meet specific needs Issues of quality, accuracy, relevance, credibility, format and accessibility relating to digital information How to assess the profile and visibility of digitally published information using analytic functionality and tools The need to be a critical user of digital technologies The importance of citation of digital resources in learning and research contexts	Understands: The need to handle, store and disseminate digital information and data in a responsible and ethical way Issues of plagiarism The principles of citing and referencing digital sources and formats to enable verification The need to keep systematic records of digital sources using relevant technology How technologies can be used to personalise individual and shared digital environments How security profiles can be used to manage levels of interaction	Understands: The need to select a communication approach suitable for the audience Issues around accessibility of digital information, formats and compatibility with accessibility software The importance of online security and privacy How to communicate appropriately online The need to consider the digital self and ones online presence That new technologies allow for information in new ways (blogs, wikis, open access)
Is able to: Recognise the importance of skills in locating, creating managing and sharing information through a variety of digital forms Identify gaps relating to the use, application or development of digital environments and tools Continuously assess how the use of digital content and tools could enhance academic practice Recognise where digital solutions can meet a specific information task or need	Is able to: Identify gaps in knowledge relating to digital tools or content Identify search tools for locating quality digital material Assess different digital formats and select those to meet current need Use new tools and technologies as they become available and evaluate them for suitability Assess how online collaboration can enhance academic practice	Is able to: Identify appropriate online search techniques Remotely access external digital sources in order to extend opportunities for discovery Assess which form(s) of digital media best meets the criteria identified Use different online communication approaches to extend reach Assign meta-data tags to content to enable future discoverability	Is able to: Use a range of digital retrieval tools and technology effectively Access, read and download digital information and data Engage in online collaboration and networking to access and share information	Is able to: Assess the suitability of digital content for the intended audience Assess the quality, accuracy, relevance, credibility, format and accessibility of digital material Read online information critically, taking into account access restrictions Maximise discoverability of own digital material using indexing strategies	Is able to: Use appropriate tools to organise digital content and data (social bookmarking, bibliographic software) Cite and reference electronic sources appropriately Manage digital resources effectively taking account of version control, file storage and record keeping issues Personalise the digital environment according to need	Is able to: Communicate effectively in a digital environment, using appropriate tools, to meet audience needs, taking account of accessibility issues Confidently use the digital media appropriate for presentation Develop an online personal profile using appropriate networks and technologies Stay safe and, if necessary, private in the digital world Select appropriate publication and dissemination outlets to share information

Figure 4 The SCONUL 7 pillars of information literacy through a digital literacy “lens” (SCONUL, nd)

National Information Literacy Framework (Scotland)

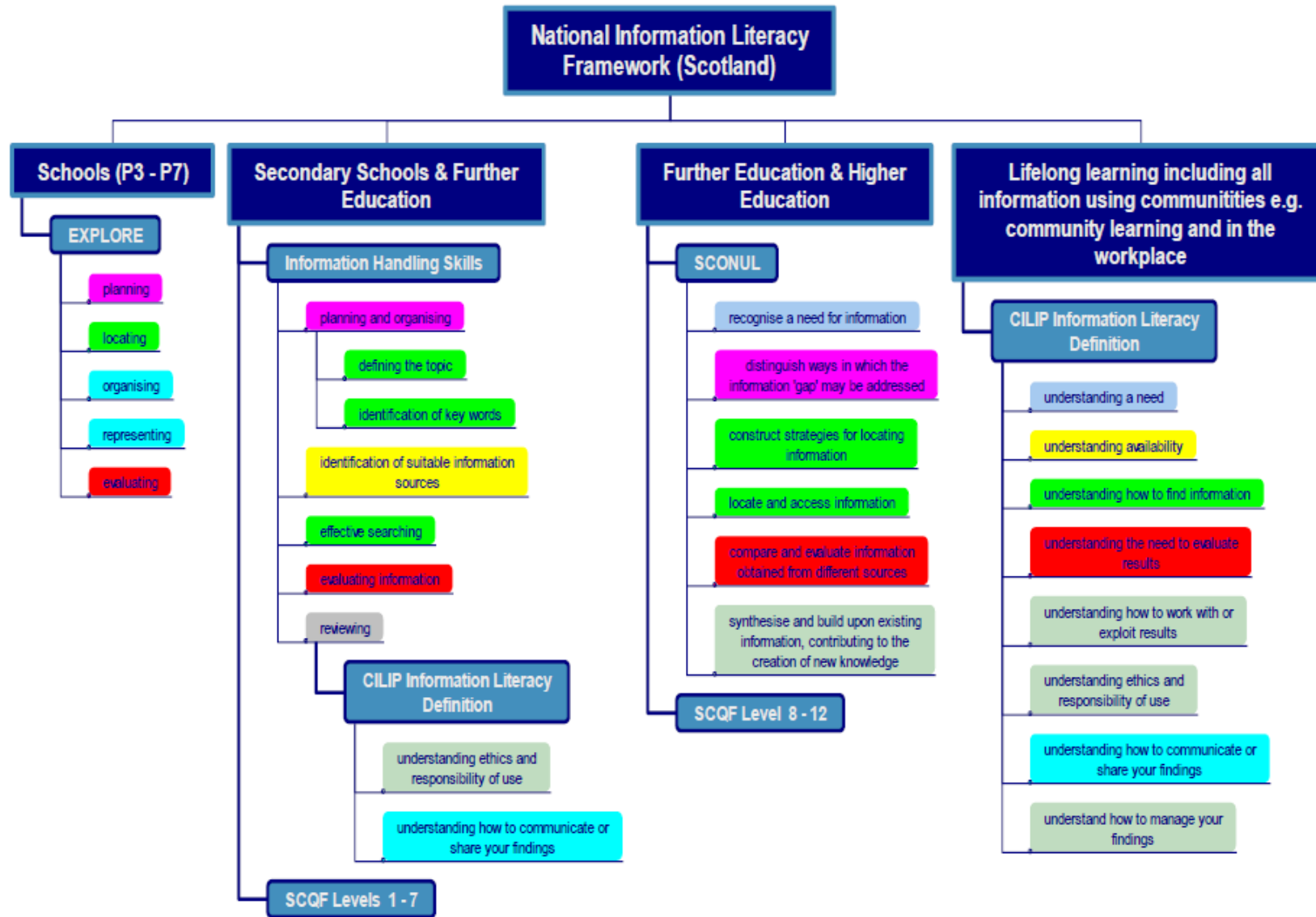


Figure 9 Overview of National information literacy framework, Scotland

ANCIL Framework

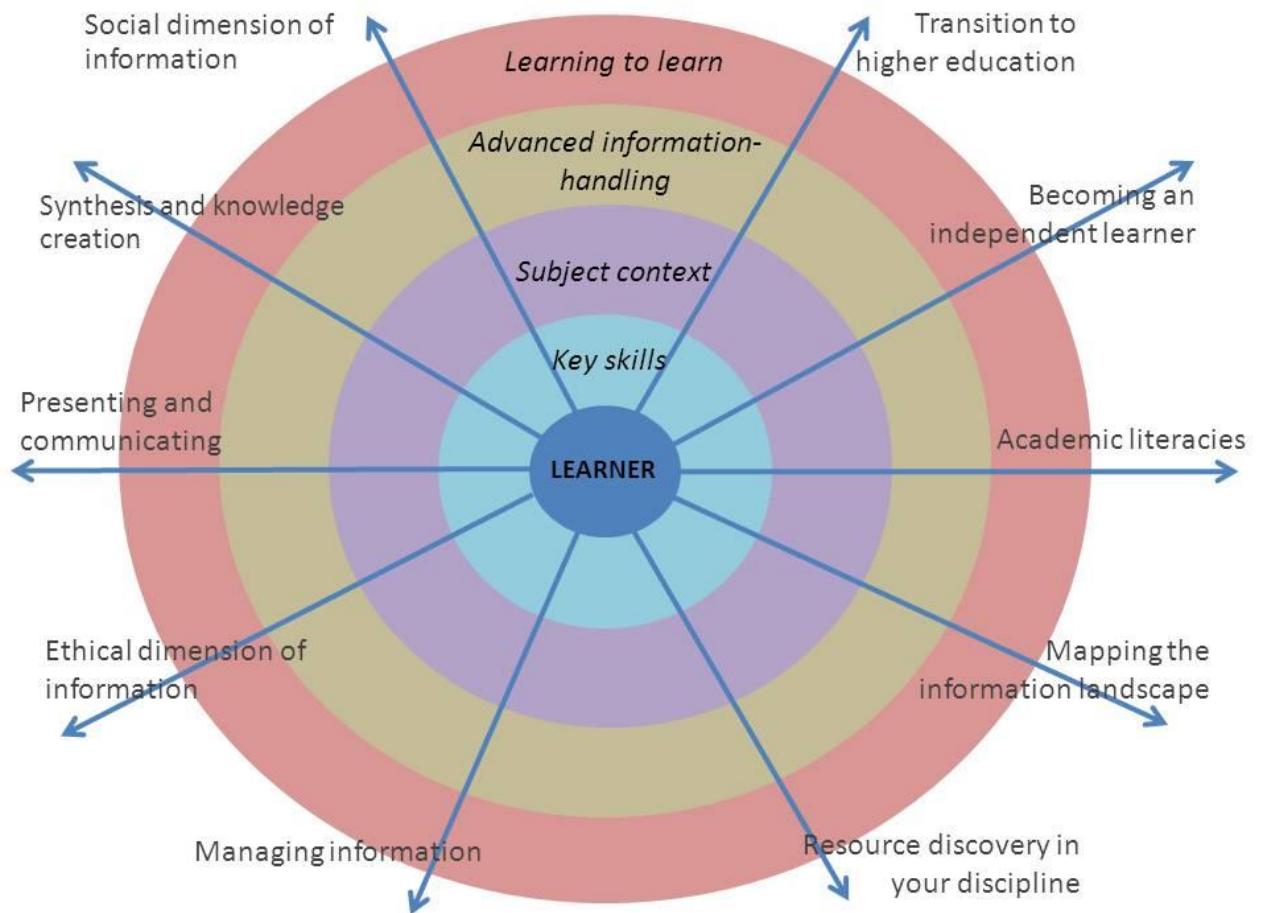


Figure 6 ANCIL framework (Secker & Coonan, 2011)

A NEW CURRICULUM FOR INFORMATION LITERACY

Learning to learn (Strands 1, 2, 10)

Developing academic literacies (Strand 3)

Subject-specific competencies (navigating the information landscape, resource discovery) (Strands 4, 5)

Key skills (e.g. searching, notetaking, referencing) (Strand 6)

Advanced information handling (e.g. evaluation, source critique, synthesis) (Strands 7, 8, 9)

Strand content	Learning outcomes	Example activities	Example assessment
Strand 1 Transition from school to higher education			
What are the expectations at higher education level in your discipline?	Distinguish between the expectations at school and HE level in your discipline Recognise that learning at HE is different and requires different strategies Identify and assess the range of information formats available	Tutor outlines contrasting expectations at secondary and HE levels Students review examples of HE level work at school and discuss differences with their prior work Classroom-based activity to explore and contrast how information on a relevant topic is presented in monographs, journals, reports and other formats	Short reflective piece of writing on transition issues – students identify areas they need to address (ideally assessed by personal tutor or academic)
What are the conventions around reading, writing and presenting at higher education level in your discipline?	Develop an awareness of academic conventions at HE level Assess your reading, writing and presenting skills and compare them to experts within your discipline	What makes an academic journal article different from an article in a publication like <i>History Today</i> or <i>New Scientist</i> ? Identify the differences in presentation, attribution, tone of voice etc.; discuss why those genre conventions are used - what purpose do they achieve? discuss what a basic descriptive answer might be and what would need to be added to take a more analytical approach	Rewrite a paragraph from a popular publication as though for an academic audience. (For peer assessment.)
Reflect on your current and previous information	Assess your current information-seeking behaviour and compare it to experts within your discipline	Using reading lists as a starting point, identify the key types of information that	Postcard from the edge: identify 3 new strategies, tools or sources that

9

Figure 7 Sample of output from the ANCIL project – a new curriculum for information literacy (Secker & Coonan, 2011)

Evaluating

Sample 'digital' activities to help learners meet outcomes of the type. Click on an activity for ideas on implementation:

- [Share solutions to a problem online: review and comment on other people's contributions](#)
 - Commenting function in googledocs (private)
 - Review or comment function in social media sites (private)
 - Annotation of pdfs
- [Explore the implications of using a particular technology, or using digital technology to address a particular research, study or professional issue](#)
 - Any
- [Evaluate a range of online resources and produce a summary of the topic with links to validated sources](#)
 - Google, google scholar and other search engines
 - Scholarly databases and catalogues with search facilities
 - Open repositories and data archives with search facilities
 - Wiki post or other digital medium for reporting findings
- [Moderate a discussion](#)
 - Text based conferencing
 - Video conferencing
 - Collaboration environment e.g. collaborate
- [Draw conclusions linked to evidence](#)
 - Blog post or wiki page with links (internal or external)
 - Spreadsheet or database application with graphical outputs used as evidence
- [Edit a presentation/article from a range of contributions](#)
 - Wikispaces or wiki site
 - Presentation software
 - Collaborative authoring software e.g. googledocs, buzzword
 - Storify
 - Social referencing tool e.g. mendeley or shared bookmarking e.g. delicious
- [Describe and apply a method for reaching a decision, including criteria used](#)
 - Decision-analysis software
 - Mapping software

Figure 8 Sample mapping of Blooms Taxonomy and digital activities as created by the CASCADE project Exeter University (<http://as.exeter.ac.uk/cascade/digital-curriculum/teaching-resources/interactivedigitalbloom/#ExploreANew>)

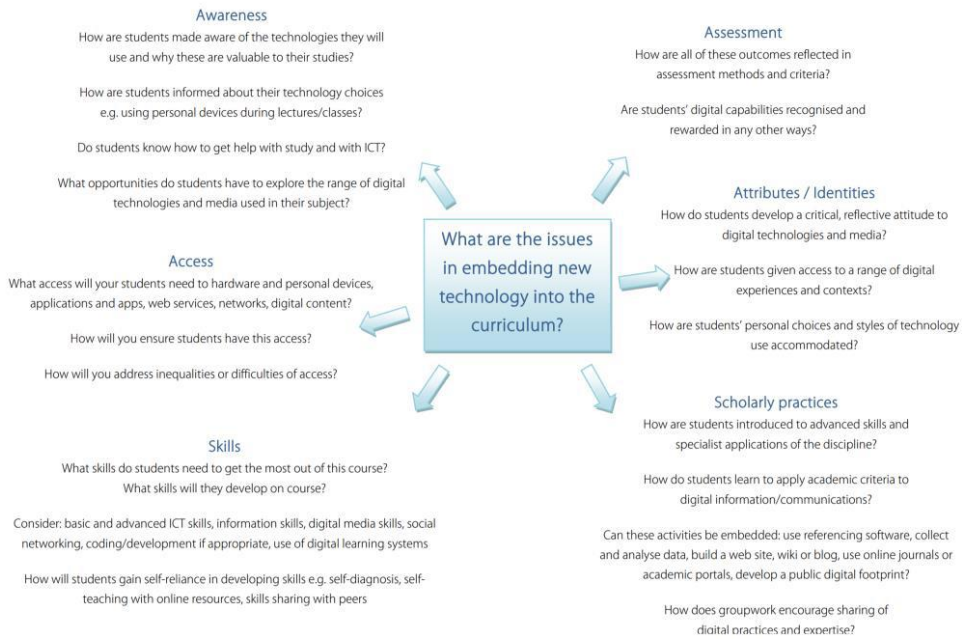


Figure 9 Digital planning checklist as developed by Exeter University for the CASCADE project (University of Exeter, 2011a)

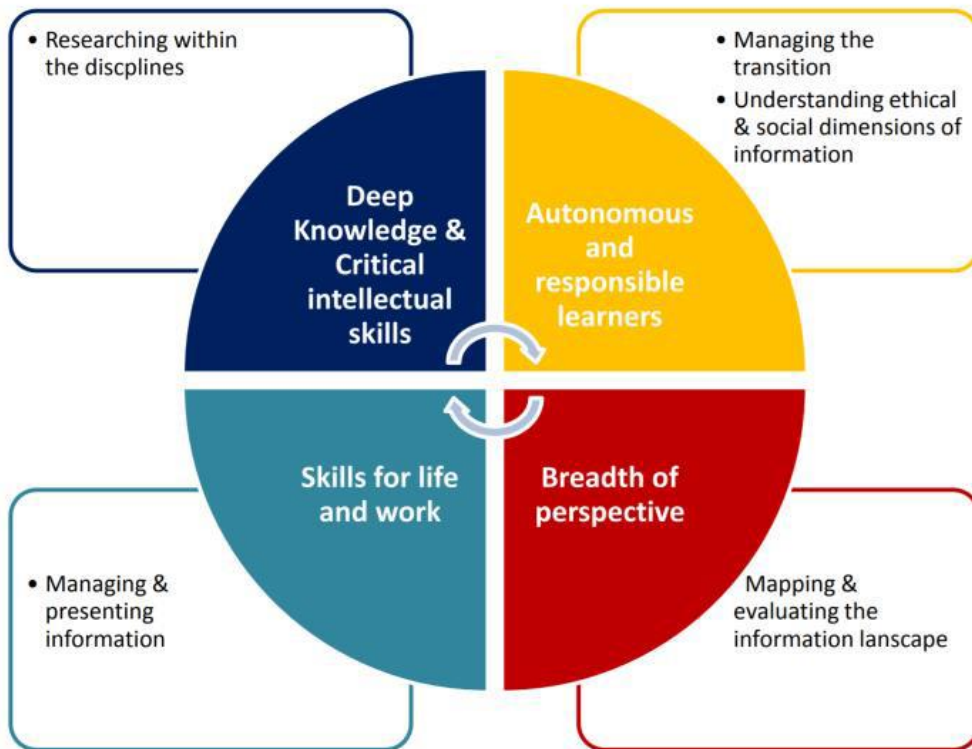


Figure 10 Information literacy Framework for "A Maynooth Education" (Maynooth University)

A3. Constructive alignment for adapted learning outcomes in the proposed framework

Table 2 Constructive alignment for adapted learning outcomes in the proposed framework

Bloom's taxonomy Level	Learning outcome (revised from ANCIL framework)	Teaching and learning methods	Assessment
Understand	Identify the IL needs for Higher Education level in your discipline (Learning to Learn Strand 1)	Serious games providing list of desirable learner features in his/her profile	Priority given to different skills and attributes selected as important for IL when compared with ANCIL model
Understand	Identify key sources and finding aids in your discipline - e.g. catalogues, full-text databases, abstract and indexing services (Developing academic literacies Strand 3)	Serious games providing options on different sources and support with costs implication: student has to decide where to spend his limited resources	Scoring assigned on the basis of merit assigned to array of sources and aids identified and selected
Understand	Identify key words and searching mechanism on the resources (Key Skills Strand 6)	Serious games asking student to identify and test possible keywords for searching of relevant papers grading them from more general to more specific	Scoring assigned on the basis of array of keywords identified from more general to more specific levels
Understand	Identify the steps you can take to avoid plagiarism, deliberate or inadvertent Use correct academic practices in quoting, citing and Paraphrasing (Ethical dimension and citing Strand 7)	Serious games can require students to select best way to cite/ quote work from others and or paraphrasing	Scoring on correct citation method, and quoting
Understand	Select source material through techniques of skimming and scanning & Identify the strengths and weaknesses of selected source material (Developing academic literacies Strand 3)	Serious game can ask the student to fill his bag with relevant source material in a limited time frame. After the user is asked to sort through the material in the bag around strength and weaknesses for each paper (again in a limited time frame).	Scoring assigned on the basis of quantity and relevance of the selected material. Negative scoring assigned if selected material is not relevant

Bloom's taxonomy Level	Learning outcome (revised from ANCIL framework)	Teaching and learning methods	Assessment
Apply	Develop an awareness of the epistemological structure and values in your discipline (Subject specific competencies Strand 4)	Game requires student to Assess and compare the quality of 3 short pieces of writing in the discipline and rank them according to criteria. The student establish weights of criteria too	Ranking results benchmarked against set values and other students results
Apply	Organise your files (including naming and organising folders) Decide on an appropriate information management technique suitable for your discipline (Managing information Strand 6)	Serious games to provide scatter resources and ask the student the best way to organise them in folders and or in a taxonomy/tree structure within a time limit. Using a mind/map technique	Scoring on thematic analysis structure identified to organise papers amount of papers organised
Analyse	Use language appropriately in your academic writing Analyse competing arguments and the use of evidence to justify a position (presenting and communicating knowledge Strand 8)	Serious games to ask debate pro and against selected arguments: student will be required to Comment critically on the views of the authors identified- working in pairs, their work is judged by the peers	Scoring assigned on the basis of peers votes selected for each debating team
Analyse	Organise strategies for assimilating new knowledge Identify your learning style and preferences, including specific learning needs (Strand 2 Becoming an independent learner)	Students will be asked to identify their needs for each level of the Bloom's taxonomy. The game consists in arranging verbs from Bloom's Taxonomy on a scale into higher- and lower-order skills and mark own needs against each	Self-reflection activity and criteria comparison. Scoring also assigned on the basis of self-correction against the actual Bloom's taxonomy scale
Evaluate	Evaluate bibliography and reference management tools and strategies in the light of your own workflow (Strand 6 Managing information)	Assign the task of produce a comparison and exploration of different reference management software. Students will be asked to write a review and discuss pros and cons of each;	Students will be evaluate don't he basis of a timed assessment in of an appropriately formatted bibliography from a reference list supplied using a selected tool
Evaluate	Use information sources appropriately to develop or support your argument (Subject specific competencies Strand 4)	Students can propose/choose a thesis to validate and a choice of material to support the argument. He will select and prioritise it	Relevance and weight for material chosen scored assigned on the basis of peer voting

Bloom's Level	taxonomy	Learning outcome (revised from ANCIL framework)	Teaching and learning methods	Assessment
Create		Use chosen information sources to articulate and analyse new problems in your field (Strand 9 Synthesising information and creating new knowledge)	Students will be given a new thesis to verify and a choice of material to support the argument. He will select and prioritise it	Relevance and weight for material chosen scored assigned on the basis of peer voting
Create		Transfer the skills of finding, critically evaluating, and deploying information for decision making in the workplace (Strand 10 Social dimension of information)	The students may be asked to work in group and search for information to answer a specific query without using any subscription resources, then carry out the same search to compare the information they can find using paid for resources.	Provide a case study on change management scenario. The activity is to be used as a formative assessment and be completed in a given time.

A4. Example of amended module descriptor incorporating IL

As an example to show how information literacy skills can be embedded into existing modules in DIT, we have rewritten the learning outcomes for TFME3002 which is a 3rd year undergraduate module on the BSC in environmental health (DT491). IL skills are particularly relevant for a module such as this one as it deals with cutting edge research and constantly changing technologies in the field of environmental management and energy generation. As such students must be able to formulate arguments which are founded on relevant and reliable studies and must be able to synthesise information and show innovation in management approaches.

M1: Module Descriptor Template

Module Code	Pre-requisite Module codes	Co-Requisite Modules code(s)	ISCED Code	Subject Code	ECTS Credits	NFQ Level (CPD)#
TFME 3002					5	
Module Title	Environmental quality and energy management					

The Title for should be repeated on each page of the Module

School Responsible: Food Science and Environmental Health.

Module Overview:

This module examines the environmental quality with a focus on air and water quality. It provides the student with an overview of the factors that influence air and water quality. It considers the management and generation of energy, associated current issues, Irish policies and resulting environmental implications. It also examines the programmes and measures adopted to monitor and manage surface water and groundwater resources.

Learning Outcomes (LO): (to be numbered)

For a SECTS module a range of 4-10 LOs is recommended

On Completion of this module, the learner will be able to:

	Original learning outcomes	Updated learning outcomes with IL embedded
1	Outline the major air pollutants of concern in Ireland, their health impacts and main sources	Outline the major air pollutants of concern in Ireland, their health impacts and main sources
2	Outline the raw materials required for and mechanisms of energy generation using traditional and modern techniques	Outline the raw materials required for and mechanisms of energy generation using various techniques
3	Critically analyse and compare the environmental impacts resulting from the use of traditional fossil fuels with newer sustainable energy technologies.	Use appropriate information sources to develop and support arguments for traditional and modern energy generation techniques
4	Assess and identify steps to moderate, as necessary, the impacts of energy use on air quality	Critically analyse and compare the environmental impacts resulting from the use of traditional fossil fuels with newer sustainable energy technologies.
5	Examine current EU and national policy measures in relation to air quality and identify the areas where key policy decisions are required	Assess and identify steps to moderate, as necessary, the impacts of energy use on air quality
6	Understand the threats and vulnerabilities of ground and surface waters	Examine current EU and national policy measures in relation to air quality and identify the areas where key policy decisions are required
7	Understand technical data relating to biological and chemical analyses of water resources and EU and national plans devised for water resource monitoring and protection	Understand the threats and vulnerabilities of ground and surface waters
8		Identify key data sources relating to biological and chemical analyses of water resources on a national and European scale
9		Synthesise current and recent literature to assist in the creation of combined environmental and energy management plans.

A5. Graduate attributes

Table 3 DIT Graduate Attributes, source: DIT 2018

Graduate Attributes	Description
Engaged:	Civically engaged, socially responsible graduates with an international outlook who contribute meaningfully and positively in their professional, community and social environments.
Enterprising:	Graduates who have the skills, knowledge and attributes needed to apply creative ideas and innovations and to find practical solutions.
Enquiry based:	Graduates with a spirit of curiosity and a desire to learn, motivated to draw upon existing knowledge, generating new ideas, seeking out learning opportunities, exploring the application of theory to practice and actively creating new knowledge
Effective:	Effective, highly skilled and confident graduates with the capacity to achieve desired results, believing that they can make a positive difference.
Expert in chosen subject discipline:	Graduates with the professional knowledge and capacity independently to practice, reflect, review and build upon disciplinary expertise and judgment.