

# A Critical Review of ICT Skills for Higher Education Learners

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**Abstract**— Possessing appropriate ICT skills has become necessary to meet the demands of the knowledge driven economies. Therefore, the transfer of those skills to Higher Education learners must be accomplished effectively. The purpose of this paper is to analyse the literature on computer-based ICT skills and the categorisation of those skills. This paper outlines the findings from literature towards determining how computer-based ICT skills have been documented, identified and categorised. Despite numerous authors' contributions, the consolidated categorisations of computer-based ICT skills have not been published. We outline the findings of a comprehensive literature analysis to chart the identified computer-based ICT skills and an initial categorisation into technical and non-technical skills, each with their own sub-categories. The results are further deconstructed to present relationships between the skills and the categorisation.

**Keywords**—Computer-based ICT skills; ICT skills; Higher Education;

## I. INTRODUCTION

The purpose of this paper is to explore the literature on computer-based ICT skills and the categorisation of those skills. In particular, this paper focuses on the computer-based ICT skill set that is required by learners to effectively engage in Higher Education in preparation for their future careers.

Literature points to Higher Education in general as having to ensure that their learners are provided with the necessary ICT skills [1, 2]. The trend is as a result of the changing labour market where ICT skills are considered a prerequisite to securing professional employment [3]. Lanvin and Passman [2] indicate that the mastering of ICT skills will also benefit the upward and horizontal mobility of learners once they are employed.

## II. METHODOLOGY

The first step of the literature analysis was to identify relevant data sources. A keyword search was done on the keywords “ICT skills”, “digital skills”, “computer skills” and “categories of ICT skills”. The results of the keyword searches, the data sources, were selected corresponding to certain criteria. The criteria considered were:

- that the article be peer reviewed as academic publications, and
- that the article should not have been published before 2008.

The selected sources were categorised according to computer-based ICT skills listed and categorisation presented. The computer-based ICT skills in the articles were abstracted and placed in a matrix. The skills were then clustered into similar types of skills and the clusters were labelled. These clusters were then used as the categories for computer-based skills in a conceptual framework of computer-based ICT skills.

## III. DEFINITION OF COMPUTER-BASED ICT SKILLS

Lanvin and Passman [2] contend that defining computer-based ICT skills precisely is made difficult by the expanding scope and purpose of the skills as they become more pervasive and more encompassing. This is underlined by Blanco and Lopez Boo [4] who contend that although various efforts are on-going, there is currently no commonly adopted definition for computer-based ICT skills. This lack of standard classification of computer-based ICT skills makes it difficult to compare research outcomes and to detect the areas of skills requirements [5].

A number of authors have, despite this difficulty, attempted to define ICT skills. Hall, Nix and Baker [6] argue that ICT skills can be described as the confident and critical use of ICT for work, leisure, learning and communication. By contrast, Claro, Preiss, San Martín, Jara, Hinostroza, Valenzuela, Cortes and Nussbaum [7] maintain that ICT skills encompass the capacity to solve problems of information, communication and knowledge in the digital environment. Furthermore, Oliver and Towers [8] embraced the view that ICT skills can be described “as the set of skills and understandings required by people to enable meaningful use of ICT appropriate to their needs.”

#### IV. CATEGORIES OF COMPUTER-BASED ICT SKILLS

The literature survey was carried out to establish which categories of computer-based ICT skills, if any, had been identified.

Lotriet, Matthee and Alexander [9] state that computer-based ICT skills range from basic skills required by individuals to more advanced skills required by ICT professionals, as well as those skills that are needed by managers in organisations where the managers are allowed to use ICT efficiently and innovatively. It is important to remember that there are different ranges and levels of ICT skills, and that these ranges and levels can differ between developed and developing countries. What is considered basic computer skills in a developed country can be considered more sophisticated skills in a developing country [3].

In developed countries basic computer-based ICT skills can be described as the abilities required from an individual to effectively utilise ICT systems and devices in their work [10].

A classification of computer-based ICT skills for developing countries are suggested by Akoojee, Arends and Roodt [11] as being lower levels skills, intermediate-level skills and higher level skills. These skills are defined by the type of occupation of the person possessing the skills have which are as follows:

- The lower level skills occupations also require considerable ICT know-how and, therefore, are not excluded from the intermediate level categorization.
- Workers in the intermediate level skills category include those who rely either exclusively or reasonably extensively on both computer technology and communication technology for the successful accomplishment of their core function.
- High levels-skills occupations are characterized by the specialist nature of ICT work associated with software and hardware development, and the support and maintenance required for this to take place.

Atasoy, Banker and Pavlou [12] and Cox, Edgar, Munise and Johnson [13] support this description by basing the categories on how advanced the skills are, and they categorise the skills into basic IT skills, medium-level IT skills, and advanced IT skills. A further example of this is the categories used by Ben Youssef, Dahmani and Omrani [14], which divide computer-based ICT skills into four categories, namely operational, formal, information and strategic ICT skills, which are described as follows:

- Operational ICT skills entail the very basic skills to operate a computer.
- Formal ICT skills include the operational skills and the use of some basic Internet applications.

- Information ICT skills encompass the first two categories, namely operational and formal ICT skills, as well as the utilisation of ICT as a learning tool.
- The final category includes strategic ICT skills, which are those skills that enable the intensive use of ICT to collaborate with other users.

Not all authors agree with the categorisation of computer-based ICT skills as basic, intermediate and advance skills. Blanco and Lopez Boo [4] distinguish three categories of computer-based ICT skills according to who the users of the skills are. These groups are:

- Basic user: A person with these skills is a competent user of generic tools (e.g. Word, Excel, Outlook, and PowerPoint).
- Advanced user: A person with these skills is a competent user of advanced and often sector-specific, software tools.
- ICT specialist: A person with these skills has the ability to develop, operate and maintain ICT systems.

The European e-skills Forum has a similar approach to categorisation of computer-based ICT skills, in that they identify the user of the skills, rather than the technicality of the skills. The categories put forward by the European e-skills Forum are the following:

- ICT user skills, which are those skills acquired by an individual for the effective application of ICT systems and devices,
- ICT practitioner skills, which are those skills needed for the research, development, design, management, production, consulting, marketing and selling, integration, installation, administration, maintenance support and servicing of ICT systems, and
- e-business skills, which are required to utilise the Internet to guarantee more effective performance of different types of organisations, to discover new ways of conducting business, and to establish new businesses [2].

In contrast Hall, Nix and Baker [6] divide computer-based ICT skills into two categories based on what is done with the information. These categories are:

- information literacy, defined as the ability to find and utilise information (including searching for, evaluating and referencing information), and
- ICT skills, which are defined as those skills that are used to organise, present or share information utilising a computer through word processing, spread sheets, presentation software and email.

A fourth strategy to categorise computer-based ICT skills is used by Claro, et al. [7] in which the skills are divided into three categories, namely: information fluency, effective

communication, and ethics and social impact. Each of these categories is then further divided into two sub-categories.

Information fluency comprises the ability to search, select, evaluate, and organise information in a digital environment. It further involves the transforming of information to create new knowledge, or sources of information for new ideas. Its two sub-categories are:

- ICT fluency in the sourcing of information, including the abilities to search, select, evaluate, organise and manage digital information, and
- ICT skills for the processing of information. This includes the analysis, refinement and representation of information, the generation of new information and the development of personal ideas.

The effective communication skills category is seen to include social skills, such as writing emails and participating in chats, which enable users to interact and contribute within a group or community. The two sub-categories are:

- effective communication skills (the ability to communicate information while ensuring that the meanings are transferred effectively, taking into account the media and the recipient), and
- collaboration and virtual interaction skills (the ability to interact in virtual networks and the utilisation of ICT to exchange information, negotiating agreements and decision making with peers).

The third skills category defined by Claro, et al. [7], ethics and social impact, include those skills that can improve the general ethical foundation of users which is affected by the specific ethical dilemmas and security issues generated by ICT. This category is divided into:

- the evaluation of the responsible use of ICT, which concerns the ability to decide about the legal, ethical and cultural restrictions in the utilisation of ICT through understanding the possible risks involved in the use of the Internet, and
- the evaluation of the ICT social impact, which considers the understanding, analysis and evaluation of the impact of ICT in social, economic and cultural contexts.

Considering the diversity of the categories presented above, a distinct need exists for one consolidated framework of computer-based ICT categories. This paper summarises and categorises the listed computer-based ICT skills into such a framework. The result is presented in the next section.

## V. FRAMEWORK OF COMPUTER-BASED ICT SKILLS

The tabulated computer-based ICT skills given in Appendix A were further analysed and, using sound judgement, grouped into two distinct categories:

- Technical computer-based ICT skills, and

- Non-Technical computer-based ICT skills.

The technical skills are those computer-based ICT skills that are used to organise, present or share information utilising a computer. The categories of technical skills are shown in Figure 1.

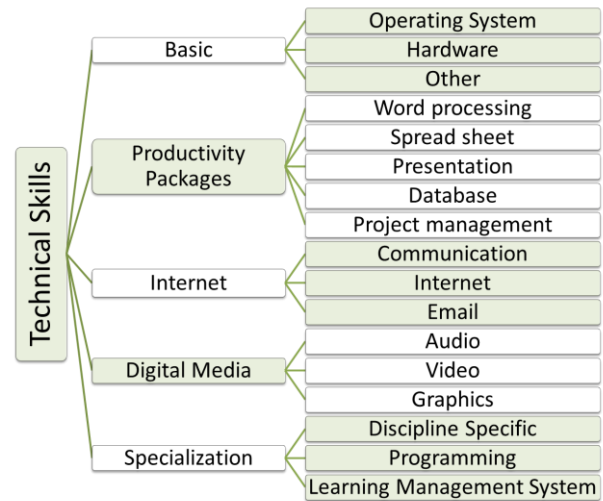


Fig. 1. Technical skills categories

The computer-based skills abstracted from the literature were clustered with similar skills and the categories for the technical skills emerged. The categories are briefly defined as:

- Basic skills: skills that do not apply to a particular package, but are required to accomplish more generalised tasks such as those that apply to operating systems and hardware.
- Productivity packages: skills required to increase productivity through the use of software, such as word processing, spread sheets and project management.
- Internet: skills required to utilize the features of the Internet, such as online communication, emailing, information searches, and retail activities.
- Digital Media: skills required to acquire, create, manipulate or manage digital media, including audio files, video material, and graphics.
- Specialization: skills required to utilize specialized software such as programming languages, custom software, and learning management systems.

The non-technical skills are those skills required to use computers to address social and organisational issues in an effective and responsible manner. The categories of non-technical skills are shown in Figure 2.

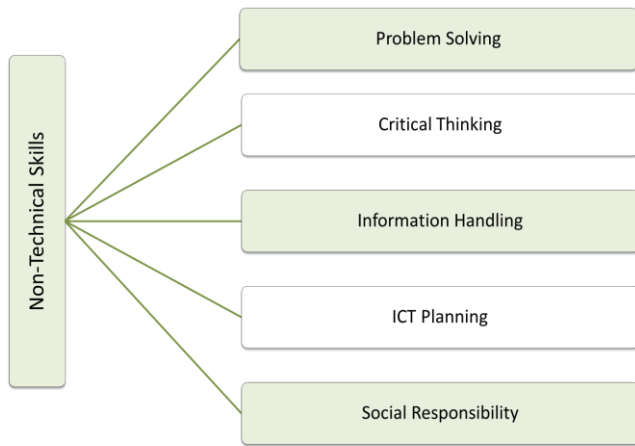


Fig. 2. Non-technical skills categories

The non-technical skills are those skills required to utilize ICTs to solve problems in a responsible manner. Categories identified from literature are problem solving, critical thinking, information handling, ICT planning, and social responsibility. A potential category that did not emerge from literature, but which is increasingly becoming more critical to the use of ICTs is that of security.

#### VI. EXAMPLES OF COMPUTER-BASED ICT SKILLS

Ben Youssef, Dahmani and Omrani [14] indicate that learners can acquire computer-based ICT skills through learning by doing and through learning by using.

Building on the contribution of various authors this paper summarises the described examples of computer-based ICT skills. The results were tabulated and are presented in Appendix A.

In order to gain insight into the range of skills attributable to the various authors, Figure 3 illustrates the relationships between the number of skills and categories.

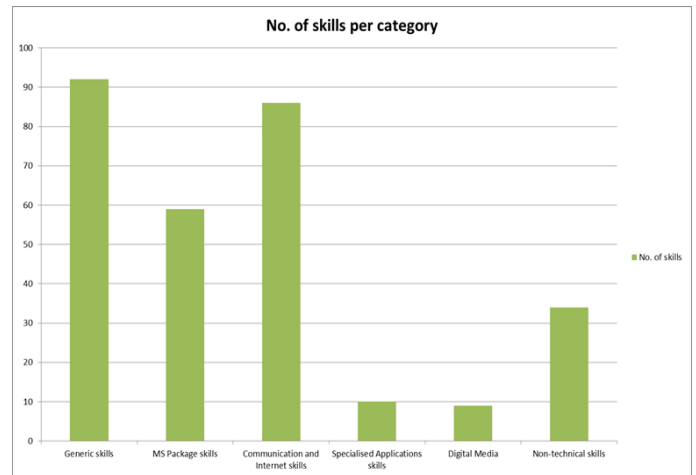


Fig. 3. Numbers of skills per category

#### VII. COMPUTER-BASED ICT SKILLS FOR HIGHER EDUCATION LEARNERS

From the above discourse, it is clear that many computer-based ICT skills have been documented and identified. However, it is also clear that those computer-based ICT skills had not previously been categorised into skills sets for specific purposes. The contribution of this paper is to propose a skills set classification which consists of two main categories, namely technical skills and non-technical skills. The technical skills category was sub-divided into basic skills, productivity packages skills, Internet skills, digital media skills and specialization skills. The non-technical skills category was sub-divided into problem solving skills, critical thinking skills, information handling skills, ICT planning skills and social responsibility skills.

Using these results, the next phase of this study is proceeding in which a literature survey is being conducted to determine the range of mobile-based ICT skills that Higher Education learners typically possess. In addition, future work will also include the mapping of the computer-based ICT skills identified in this paper to the mobile-based ICT skills of Higher Education learners, in order to construct an integrated ICT skills set that can be transferred to Higher Education learners in preparation for their careers.

#### VIII. CONCLUSION

A review of the literature has shown that numerous authors have presented their cases on what they consider the computer-based ICT skills are that are needed by different users. Using the computer-based ICT skills found in the literature, a summary of the skills was constructed as a concept framework, and the skills were grouped into technical and non-technical categories, each with appropriate sub-categories.

These results will be used in conjunction with the results of a mobile-based ICT skills literature survey to produce a complete ICT skills set for Higher Education learners.

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