Contests as a Way for Changing Methodologies in the Curriculum

Javier Bilbao, University of the Basque Country, Spain
Eugenio Bravo, University of the Basque Country, Spain
Olatz García, University of the Basque Country, Spain
Concepción Varela, University of the Basque Country, Spain
Miguel Rodríguez, University of the Basque Country, Spain

The European Conference on Education 2014
Official Conference Proceedings

Abstract
Digital Competence involves the confident and critical use of Information Society Technology for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet. Some arguments cited for promoting the inclusion of ICT in education are the potential benefits of ICT for teaching and learning, the pervasiveness of technologies, and the necessity for present people of being functional in our knowledge society.

Education standards need to include the kind of skills and competences that can help students become responsible and performing users of technology and to develop the new competences required in today's economy and society which are enhanced by technology, in particular those related to knowledge management. So, in general, it is necessary a general change in the curriculum, not related to any specific subject.

In this way, contests may do possible this change by means of small, interesting questions that can be answered without prior knowledge about Informatics. Students should learn to use information technologies in a suitable, effective way, and when learning any subject they should be capable to implement computer facilities and thus develop their learning methods. Contests are an excellent tool to achieve these goals.

iafor
The International Academic Forum
www.iafor.org

INTRODUCTION

Information and Communication Technologies (ICT) are a basic and common part of our lives. In this century, devices more powerful and smaller have taken a main role both for work and recreational aspects. And a non-finished number of applications have been developed for these devices. From European Union, government focused its attention in ICT and Informatics and recognized them as very important issues at all levels of Education. In this way, Digital Agenda for Europe [1] includes them as Pillar VII "ICT-enabled benefits for EU society".

In 2006, the European Parliament and the Council [2] published a recommendation identifying eight Key Competences for Lifelong Learning: Communication in the Mother Tongue; Communication in Foreign Languages; Mathematical Competence and Basic Competences in Science and Technology; Digital Competence; Learning to Learn; Social and Civic Competences; Entrepreneurship; and Cultural Awareness and Expression. Four years afterwards, the value of this recommendation is recognised in the Europe 2020 Strategy [3]. The 2006 recommendation already points to Digital Competence as a fundamental basic skill. Digital Competence is there defined as follows:

"Digital Competence involves the confident and critical use of Information Society Technology (IST) for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet." [2].

This definition takes into account several matters not only related to the use of ICT, but belong to them related to Computer Science. Moreover, the implementation of the idea can be extended to different levels of education –from Primary schools to University-, different fields or subjects –from subjects related to Humanities to Science, through Health or Business and Law- and different states in the life –for young or elder people, for employed or unemployed persons, etc.

THREE MAIN ASPECTS IN THE DEVELOPMENT OF THE DIGITAL COMPETENCE

Three basic aspects to be developed in order to achieve the goal of developing the Digital Competence are the knowledge, the skills and the attitude. The recommendation of the European Union provides explanation on the essential knowledge, skills and attitudes needed to be digitally competent.

We have to take the knowledge not as a mere repository of concepts that must be memorized by pupils for an examination, but as understanding of the functioning of main computer applications, from the operating systems of PCs to smart phones; of the risks of the Internet and online communication –remember that nowadays young people is almost all time connected to social nets and sometimes they do not feel the danger of sharing photos or comments-; of the role of technologies in supporting creativity and innovation; of the validity and reliability of online information –Saint Google's answers are not always contrasted and sometimes and only opinions quite

far from the reality-; of the legal and ethic principles behind the use of collaborative tools [4].

Regarding the skills, the user of ICT must manage different fields such as the ability to manage information; the capacity to distinguish the virtual from the real world and to see the connections between these two domains; the ability to use Internet-based services and to use technologies to support critical thinking, creativity and innovation. It depends on the age of the user and on the frequency of the use that the person would acquire these skills.

In terms of **attitudes**, the recommendation gauges as essential that citizens are critical and reflective towards information, that they are responsible users and interested in engaging in online communities and networks.

ICT AS A BASIC FOR EDUCATION

According to NCCA [5], there are three main frequently cited arguments for promoting the inclusion of ICT in education. The first relates to the unproven potential benefits of ICT for teaching and learning, including gains in students' achievement and motivation. The second argument acknowledges the pervasiveness of technologies, which leads to the subsequent need to acquire Digital Competence to be functional in our knowledge society [6]. As a consequence, the third argument warns against the dangers of the current digital divide that needs to be tackled to allow all citizens to benefit from being active in the digital domain. The term digital divide came into use in the 90's to allude to the differences in access to ICT and the Internet [7]. As argued by Molnar already in 2003, new types of digital divide have emerged that go beyond access [8]. In this line, Livingstone & Helsper built taxonomy of uses defining gradations of digital inclusion as a ladder of participation [9]. In their paper, instead of proposing a new binary divide – as it was the case for the "Falling through the Net" report [10], which splits haves and have-nots – Livingstone & Helsper propose a continuum of use, which spreads from the non-use of Internet to low and more frequent use. After a focus on first access, and then use, a third subsequent perspective of the digital divide moved towards competence. Erstad argues that digital inclusion depends more on knowledge and skills than on access and use [11].

In a similar direction, digital ´rhetoric´ discourses claim the necessity to develop digital literacy for full participation in life [12], while policy documents often emphasise the need to invest in digital skills enhancement for economic growth and competitiveness [3], [13]. Computer-related proficiency, according to yet another digital rhetoric strand, is the key to employability and improved life chances [12]. According to Magyar, Digital literacy should be acknowledged and guaranteed as a Human Right [14]. In the last decade competences related to the use of ICTs and technologies have started to be understood as "life skills", comparable to literacy and numeracy, therefore becoming "both a requirement and a right" [15].

In 2013, European citizens are not ready to face digital competence requirements. Eurostat data show that there are several categories with low digital skills – in terms of computer skills and internet skills; namely: the elderly, the inactive, and the low

educated [16]. Even the youngest generations, although being known as 'digital natives' [17], are not necessarily scoring high in terms of Digital Competence in international tests. Students did not perform well in Pisa 2009 online reading [18]: only 8% of respondents were considered as having high competence, showing the ability to use the Internet in an efficient way, valuing the credibility and usefulness of information [19]. A recent policy brief reporting data for the UK claims that in Britain media literacy levels – highly related to digital literacy – are currently stalling, and government is called upon to take measure against this lack of progress [20].

CHANGE IN THE EDUCATION SYSTEM

According to OECD [21], "education standards need to include the kind of skills and competences that can help students become responsible and performing users of technology and to develop the new competences required in today's economy and society which are enhanced by technology, in particular those related to knowledge management" (p. 14). In the referred report, these skills were defined to include processes related to knowledge management in network environments. Moreover, it stated that these skills should be gained at school. Such a broad definition leaves open the question about in which specific subject domains or on which school levels the elements of digital competence should be taught.

One of the few papers that provide some answers to the question is Erstad´s [11]. He broadened digital literacy to media literacy and suggested the following aspects of media literacies as part of school-based learning: 1) Basic skills, 2) Media as an object of analysis, 3) Knowledge building in subject-domains, 4) Learning strategies, and 5) Digital Bildung/ Cultural competence. Besides this, Erstad emphasized user-generated content creation (Web2.0, editing software) in which students have an active role in knowledge practices.

Another study about the role of digital competence in the curriculum was conducted among teachers of informatics oriented subjects in the Czech Republic [22]. The respondents answered to a ready-made questionnaire. Teacher respondents considered that the most important units for developing information and technology literacy of elementary school students were 1) word processing, 2) basic user skills, work with operation system, file management, 3) information seeking and communication, and 4) work with spread sheets. As the authors said, the respondents often tended to mark those competences they master themselves, and point out as unimportant the ones in which their IT competence was lower.

In several reviewed articles, an essential conclusion was that there is a need for changes in the curriculum, in structures, in teachers' competence, etc. before schools can provide students with relevant competences and skills.

On the one hand, there is necessary a general change in the curriculum, not related to any specific subject. This was emphasized by Erstad [11] and Hague & Williamson [23]. Erstad regarded knowledge building in subject-domains essential. New technologies change fundamental issues within school subjects (e.g. calculators in mathematics). Knowledge is interconnected with the cultural tools we have, and not only with "content", and tools change over time. It is important to have knowledge-

building skills, not specific technology skills. Based on his own study using project work, Erstad explained that digital media was both a resource for students' learning, as well as a tool for reflection on information sources, their collaboration within and between schools, and content creation – all of which were not related to some limited subjects of the curriculum.

On another hand, some changes in the assessment practices must be implemented. In his article, Erstad [11] described how students' digital competence is evaluated in schools in different countries. Several of the studies he used for reference purposes showed a clear connection between students' digital competence and their parents' socio-economic status. Schools have not been able to bridge this gap.

In describing the gap between outside and inside of school' digital literacy practices O'Brien and Scharber [24] wrote about the gap in official standards and assessments. Students' outside "texts" are multimodal digital ones but the assessments are almost exclusively based on printed texts.

An interesting change has happened during the last ten years: while the question "Should ICT be a separate subject or integrated in other subjects" was a burning question 10-15 years ago, none of the recently published papers reviewed discussed this issue – it appears to be so self-evident that digital technology should be integrated in all subjects and in all learning and teaching processes. The dominant opinion in the articles was that the best way to support students' digital competence is to use technology in various school subjects and for various purposes. Allen [25] stated that there should be a school-wide consensus on goals, methods, and responsibilities about the acquisition of information literacy skills. Based on a survey targeted to teachers in Czech Republic, Benes, Mudrak, Prochazka, Rambousek and Stipek [22] reported that teachers favour the approach that information education is not limited to the information technology subject itself, but the development of information technology competences should be supported by the wide usage of ICT in other subjects not directly focused on informatics, and also in various educational information activities that are not directly linked to these subjects. The improvement of digital competencies or related skills can be an important additional goal or side-effect in settings where technology is used in education for other purposes, mainly learning of some subject domain content.

BEBRAS CONTEST

In 2007, the OECD Centre for Educational Research and Innovation (CERI) launched the New Millennium Learners (NML) project [26]. It has the global aim of investigating the effects of digital technologies on school-age learners and providing recommendations on the most appropriate institutional and policy responses from the education sector.

The concept of New Millennium Learners suggests that the technology uptake, particularly by younger generations, has an effect on the way people build their identities, communicate socially, and manage information and knowledge. However, the fact that young people are increasingly attached to and knowledgeable in terms of technology does not necessarily mean that they develop by themselves the range of

skills and competencies that the knowledge economy requires [27]. Today's children are thought to be flexible with computers, immediate to communicate, creative with technology, and highly skilled at multitasking in a world where ubiquitous connections are taken for granted [28].

Bringing informatics in a formal track to schools by means of curricula is quite important. However, it is necessary to support the informal ways of introducing students to informatics. So another way to bring informatics to school can be through developing attractive activities based on informatics concepts. Contests are among them. Contests are exceptionally valuable for motivating and involving pupils in computer science [29].

The International Contest on Informatics and Computer Fluency (named Bebras in Lithuanian, or Beaver in English, www.bebras.org) can be an example of bringing informatics concepts to students in an informal way. The Bebras contest started in a coordinated way: running contests at schools, where solutions may be submitted to some central authorities or some local organizers.

Any contest needs a challenging set of tasks. The Bebras tasks' developers are seeking to choose interesting tasks (problems) for motivating students to deal with computer science and to think deeper about technology. Collaboration in developing Bebras tasks during international workshops reveals six concepts significant for general informatics education [30], [31]:

- **Information:** the conception of information, its representation (symbolic, numerical, graphical), encoding, encrypting;
- **Algorithms:** action formalization, action description according to certain rules;
- **Computer systems and their application:** interaction of computer components, development, common principles of program functionality, search engines;
- **Structures and patterns:** the components of discrete mathematics, elements of combinatory and actions with them;
- **Social effect of technologies:** cognitive, legal, ethical, cultural, integral aspects of information and communication technologies;
- **Informatics and information technology puzzles:** logical games, mind maps, used to develop technology-based skills.

CONCLUSIONS

Young people do not know what a day without a mobile is. And not so young people do not imagine their present life without the smart phone, tablet or simply Internet. Internet nowadays is not only a very big network, but it has millions of services on it, and all the set is changing mankind and human society for the effects they have on the acquisition of information and on communication strategies; Internet, on-line services, applications, etc. are also influencing individuals' learning, knowledge development and, more generally, interpersonal and intrapersonal relationships.

Computer Thinking and ICT are now part of our lives and they have more leadership year by year, month by month. At the same time, they have the potential to rapidly spread across regions. To indeed this propagation, young people take Informatics and ICT as a common, natural and useful part of their way of life.

Educational systems also have to modernize their curricula. Several subjects that are not specifically part of Informatics use it as a very practical tool. Like Mathematics or Physics with calculators some decades ago, different methodologies are incorporating concepts, manners, tools, software, etc. to improve and make easier the learning of subjects. One of these tools are the contests, and particularly the Bebras Contest.

The Bebras Contest has small, interesting questions that can be answered without prior knowledge about Informatics, but are clearly related to Informatics concepts and require thinking in and about information, discrete structures, computation, data processing, as well as algorithmic concepts. That is, each Bebras task can both demonstrate an aspect of Informatics and test the participant's Informatics-related talent.

REFERENCES

[1] European Commission. (2010a). A Digital Agenda for Europe, *COM(2010)245 final*.

[2] European Parliament and the Council. (2006). Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning. *Official Journal of the European Union*, L394/310.

[3] European Commission. (2010b). Europe 2020: A strategy for smart, sustainable and inclusive growth, *COM (2010) 2020*.

[4] Ferrari, A. (2012). Digital Competence in Practice: An Analysis of Frameworks. JRC Technical Reports, European Commission.

[5] NCCA. (2004). *Curriculum Assessment and ICT in the Irish context: a Discussion Paper*. Retrieved from http://www.ncca.ie/uploadedfiles/ECPE/Curriculum%20AssessmentandICT.pdf .

[6] Eshet-Alkalai, Y. (2004). Digital Literacy. A Conceptual Framework for Survival Skills in the Digital Era. *Journal of Educational Multimedia & Hypermedia, 13*(1), 93-106.

[7] Irving, L., Klegar-Levy, K., Everette, D., Reynolds, T., & Lader, W. (1999). Falling through the Net: Defining the digital divide. *Washington, DC: National Telecommunications and Information Administration, US Deps of Commerce*.

[8] Molnár, S. (2003). The explanation frame of the digital divide. Proceedings of the Summer School,"Risks and Challenges of the Network Society, 4-8.

[9] Livingstone, S., & Helsper, E. (2007). Gradations in digital inclusion: children, young people and the digital divide. *New media & society, 9*(4), 671.

[10] McConnaughey, J., & Lader, W. (1998). Falling through the net II: new data on the digital divide. National Telecommunications and Information Administration. Washington, DC: Department of Commerce, US Government.

[11] Erstad, O. (2010). Educating the Digital Generation. *Nordic Journal of Digital Literacy, 1*, 56-70.

[12] Sefton-Green, J., Nixon, H., & Erstad, O. (2009). Reviewing Approaches and Perspectives on "Digital Literacy". *Pedagogies: An International Journal, 4*, 107-125.

[13] Hartley, J., Montgomery, M., & Brennan, M. (2002). *Communication, cultural and media studies: The key concepts*: Psychology Press.

[14] John, M. (2010). Report on the first debate of Education Fast Forward. http://www.prometheanplanet.com/documents/uk-us/pdf/professional-development/education-fast-forward/report-on-the-first-debate-of-education-fast-forward-by-merlin-john.pdf.

[15] OECD. (2001). *Learning to change*. Paris.

[16] European Union. (2010). *Europe's Digital Competitiveness Report*. Luxembourg. Retrieved from http://ec.europa.eu/information_society/digital-agenda/documents/edcr.pdf.

[17] Prensky, M. (2001). Digital Natives, Digital Immigrants. *On the Horizon, 9*(5).

[18] OECD. (2010a). PISA 2009 Results: What Students Know and Can Do. Students performance in reading, mathematics and science. (Vol. 1). Paris: OECD.

[19] Martin, A. (2006). Literacies for the Digital Age. In A. Martin & D. Madigan (Eds.), *Digital Literacies for Learning* (pp. 3-25). London: Facet.

[20] Livingstone, S., & Wang, Y. (2011). Media Literacy and the Communication Act. What has been achieved and what could be done? London: LSE.
[21] OECD. (2010b). Are the New Milleniums Learners Making the Grade? Technology use and educational performance in PISA (2010). OECD.
[22] Benes, P., Mudrak, D., Prochazka, J., Rambousek,V., and Stipek, J. (2008). Research of ICT Education in the Czech Republic. Problems of Education in the 21th Century, 5, 24–34.
[23] Hague, C. & Williamson, B. (2009). Digital participation, digital literacy and school subjects. A review of the politicies, literature and evidence. Retrieved September 10, 2010, from http://www.futurelab,.org.uk/resources/documents/lit_reviews/DigitalParticipation.pdf.
[24] O'Brien, D. and Scharber, C. (2008). Digital literacies. *Journal of Adolescent & Adult Literacy*, 52 (1), 66-68.
[25] Allen, S. M. (2007). Information literacy, ICT, high school, and college expectations. *Knowledge Quest, 35*(5), 18-24.
[26] OECD Centre for Educational Research and Innovation (CERI). (2007). New Millennium Learners (NML) project (http://www.nml-conference.be/).
[27] Dagiene, V. (2011). Informatics Education for New Millennium Learners. Informatics in School, Contributing to 21st Century Education, ISSEP 2011, pp. 9-20.
[28] Pedro, F. (2006). The New Millennium Learners: Challenging our Views on ICT and Learning. OECD-CERI.
[29] Dagiene, V. (2010). Sustaining informatics education by contests. In: Hromkovič, J., Královič, R., Vahrenhold, J. (eds.) ISSEP 2010. LNCS, vol. 5941, pp. 1-12. Springer, Heidelberg.
[30] Dagiene, V., Futschek, G. (2010). Introducing Informatics Concepts through a Contest. In: IFIP Working Conference: New Developments in ICT and Education. Universite de Picardie Jules Verne, Amiens.
[31] Dagiene, V. (2008). The BEBRAS Contest on Informatics and Computer Literacy – Students (Drive to Science Education). In: Joint Open and Working IFIP Conf. Kuala Lumpur, pp. 214-223.