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Channeling Digital Convergence in Education for Societal Benefit

The advent of the information revolution has led to the digitalization of society, affecting virtually all of its concerns. The interaction between digitalization and the globalization of the planet has created a convergence with technological, social, and cultural implications. We argue that viewing the interaction of digitalization, globalization, and convergence within a framework of service to society may provide a foundation for formulating information and communication technology (ICT) core curricula with human development and community prosperity as central objectives.

ICTs have emerged as instruments of social interaction. Their extraordinary influence permeates all human affairs, and their revolutionary impact affects the way people live, work, and learn, as well as the way governments, private organizations, and citizens relate.

It is evident that the impact of ICT already permeates all educational endeavors. This impact, in our view, is further enhanced by the emergence and adoption of digital convergence. In this exploratory approach, we delineate elements for digital convergence adoption that are not limited to a merely technological perspective. We conceptualize digital convergence as a process in which technology coevolves with other disciplines, creating a dynamic system where human interaction is essential. In this perspective, digital convergence adoption in educational contexts goes far beyond the use of ICT in everyday educational activities. Cultural, social, ethical, and economic elements interact and become crucial ingredients in a new setting where collaboration and cooperation emerge as essential for the training of new generations of ICT professionals.

The impact of ICT is not simply a result of the development of technology; the capacity for technology adoption by organizations and individuals has become a crucial requirement for exploiting the full potential of ICT. This is particularly relevant in academic contexts where human activity requires the establishment of an environment that promotes creativity, sustainability, collaboration, interdisciplinary focus, and social responsibility [1]. The adequate integration of all these elements provides an innovation scenario for learning in which disciplines converge and individuals of many talents interact, requiring in turn new mechanisms of organization and management. This integration is, in our opinion, a significant challenge faced by universities in the new millennium.

From an economic perspective, digital convergence can be seen as the opportunity to offer consumers information, communication, and entertainment

Digital Object Identifier 10.1109/MTS.2014.2363979
Date of publication: 1 December 2014

products and services that are integrated and universally accessible. By the same token, digital convergence offers the possibility of improving the operations and organizational structure of different segments of the value chain of corporations, government agencies, and nongovernmental organizations. From the sociocultural perspective, digital convergence expands the range and availability of tools for accessing the Internet, thereby increasing the possibilities for interaction and collaboration between people. However, some authors have expressed concern that such digital interaction may actually decrease other more relevant types of human encounters [2], [3]. Nevertheless, changes in education do not arise simply as the result of a purely technological process; various factors of a diverse nature — cognitive, psychological, social, ethical — impact the way people learn and access educational resources. Furthermore, a highly competitive knowledge-based society with a free exchange of products, services and ideas requires transcendental changes and continuous innovation in its educational efforts in order to train the human resources that human prosperity and sustainable development demand.

We posit that the impact of ICT in education is enhanced by the adoption of digital convergence through the availability of a variety of integrated products and services that improve and expand the possibilities of communication, interaction and collaboration in a mobile and ubiquitous fashion. Digital convergence also facilitates the production of access to and diffusion of knowledge by means of tools for the creation and virtualization of personal learning environments not available before.

We propose that a basic framework for the development of comprehensive educational programs for future ICT engineers, scientists, and practitioners should consider the inclusion of the disciplines described in Fig. 1.

Access to information and knowledge has been dramatically changed through the pervasive influence

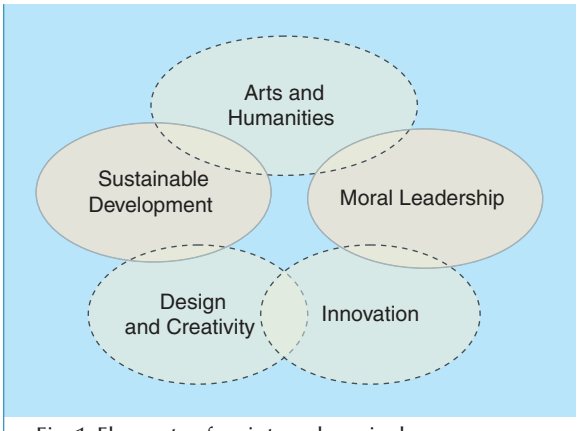

Fig. 1. Elements of an integral curricula.

of ICT. Education, research, and development have also been affected significantly, although questions regarding the pace and nature of such change call for reflection and new evaluation models, for which interdisciplinary approaches are necessary [4]. For this purpose, the reductionist perspective of most current educational programs cannot provide a society under the influence of globalization and digital convergence with adequate and effective answers. We suggest that sustainable development, arts and humanities, design and creativity, innovation, and moral leadership are critically important disciplines through whose influence the capacities of ICT could be channelled towards the goal of promoting human prosperity. There are additional elements that should be added to this proposed framework, such as those related to psychology, sociology and behavioral economics [4]. However, we have emphasized those that we consider of particular significance for understanding the role of digital convergence as potential contributors to community development and progress.

In addition to the mentioned fields, fostering a vision of service to society in ICT education is central for achieving an understanding of our interrelatedness as human beings. Fostering this vision serves to direct efforts towards the development of technologies that have the potential to mitigate the effects of socioeconomic disparities, or to address the lack of access to quality health services in all sectors of the population, or to provide support to communities afflicted by natural disasters – to cite just a few possibilities. In this scenario, moral leadership furnishes the insight and human perspective required to respond in a more effective manner to these urgent social issues, and offers an ethical foundation so greatly needed for cybersecurity concerns. Meanwhile, an innovation focus that incorporates concepts such as collaborative work, value creation, and entrepreneurship contributes necessary elements for socioeconomic development projects in key areas like green technology development. For their part, design and creativity have in recent years come to be considered areas of priority in major universities and research centers throughout the world.

The knowledge and skills required for the design of systems and devices focused on the needs of the population are in great demand all over the world. Arts and humanities constitute another integral element because they can contribute to stimulating the creative mind and to the creation of awareness and the social outlook conducive to community involvement and participation in digital inclusion projects. These disciplines are interrelated and cannot be isolated from each other or taken out of context and separated from the cultural, social, intellectual, and economic needs of the population [5]–[7].

Increased Relevance for Educational Approach

An educational approach oriented to the mitigation of the pressing social, economic, and environmental needs of the planet will have an increasingly relevant role in the emergence of new patterns of learning, interaction and behavior. The understanding, diffusion, and adoption of digital convergence in educational contexts, with its concomitant technical, sociocultural, economic, and regulatory implications, could contribute to shaping new forms of social participation and interaction. The complexities involved in the adoption of digital convergence demand substantial research to fully appreciate its nature and guide its potential contributions toward the creation of the new mentality our societies need in order to thrive in a complex and globalized world. The challenges arising as a result of the socioeconomic and cultural forces that shape education in a global society cannot be underestimated, and it is at this juncture that strategies for digital convergence adoption with a focus on service to society might be employed to great advantage.

To fully tap the potential benefits of digital convergence adoption in educational contexts, enabling it to contribute to social wellbeing, a clear understanding of the nature of our interdependent world, an ethical perspective and conduct, and finally, moral leadership, are essential.

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References

[1] H. Gardner, *Five Minds for the Future*. Boston, MA: Harvard Bus. School Press, 2006.

[2] C.N. Davidson and D.T. Goldberg, *The Future of Learning Institutions in a Digital Age*. Cambridge, MA: M.I.T. Press, 2009.

[3] C. Brown, "The evolving classroom," *Converge Special Report,* vol 2, no. 4, 2011.

[4] M.A. Max-Neef, "Foundations of transdisciplinarity," *Ecological Economics*, vol. 53, pp. 5–16, 2005.

[5] D. Brooks, "The new humanism," *New York Times*, May 7, 2011; http://www.nytimes.com/2011/03/08/opinion/08brooks.html?_r=2&ref=davidbrooks&.

[6] D. Freitag and A. Thaler, "Intervention models towards more diversity in engineering education," in *Proc. IEEE Global Engineering Education Conf. (EDUCON) 2011: Learning Environments and Ecosystems in Engineering Education*, 4-6, M.E. Auer, A.Y. Al Zoubi, and E. Tovar, Eds., 2011, pp. 518–522.

[7] *The NMC Horizon Report: 2014 Higher Education Edition,* 2014; http://www.nmc.org/pdf/2014-nmc-horizon-report-he-EN.pdf.

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The major outcome of the workshop will be a communique that will inform the preparation of SAF05 reports and CTAP position papers on the social and national security implications of RPAVs and related technologies for submission to the Australian and United States governments.

Acknowledgment

The Eighth Workshop on the Social Implications of National Security Series was a joint activity of the SSIT Australia Chapter, the University of Wollongong (UOW), the Australian Council of Learned Academies (ACOLA)'s *Securing Australia's Future* Project 5 (SAF05), the Carlton Connect Initiative (CCI), the IEEE-USA Committee on Transportation and Aerospace Policy (CTAP), and the Australian Defence Science Institute (DSI).

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