Progressing Toward Digital Equity

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Abstract. In the computer domain, the objective to be reached in order to give opportunities equality to all persons is defined as Digital Equity. However, different international organizations are working to reach this goal. The analysis of the key points for reaching this objective and how international organizations (International Telecommunications Union, United Nations, International Federation for Information Processing) are working for this goal will be presented in the paper.

Keywords: Digital equity · Building the infrastructure · Education levels · ITU WSIS · UN SDG · IFIP

1 Introduction

ICT is a set of technologies that well used should allow the progress and the wellbeing of people everywhere in the world. However as there are important differences in the current situation of people, depending on its general level of use in each country, the use of ICT to reach the progress and the wellbeing cannot be the same in all countries. To evaluate this influence of the ICT we will use the concept of Digital Equity.

Digital equity [1] is the social-justice goal of ensuring that everyone in our society has equal access to technology tools, computers and the Internet. Even more, it is when all individuals have the knowledge and skills to access and use technology tools, computers and the Internet. A simple definition of digital equity can be a state in which both the digital divide and the participation gap are bridged.

Digital equity ensures that everyone has equal opportunities to use the tools and resources needed to fully participate as a citizen in today's digitally-powered world. Lacking these opportunities causes people to encounter educational, economic and social limitations that negatively impact their quality of life. The progress towards the Digital Equity, as it is established in the IFIP strategic action, should be achieved by:

- Promoting accessibility to ICT,
- Promoting good practices,
- Promoting and enhancing appropriate access to knowledge and experiences,
- Organizing and contributing to activities aimed at achieving the goals of the World Summit on the Information Society (ITU-WSIS) [2],
- Organizing and contributing to activities aimed at achieving the UN Sustainable Development Goals (SDGs) [3], as we will analyze in Sect. 4.

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To analyze in depth the points suggested in the previous paragraphs, this paper will be organized as follows: in Sect. 2 the concept of Digital Equity will be detailed; Sect. 3 will be devoted to the relations of Digital Equity with the ITU-WSIS Action Lines; the relation of ITU-WSIS Action Lines with the UN Sustainable Development Goals will be the topic of Sect. 4. In Sect. 5 it is analyze the differences of Digital Equity in developed and developing countries and how IFIP [4] can contribute to reach these goals. Finally Sect. 6 gives some conclusions about the coming future.

2 Concept of Digital Equity

2.1 What Is Digital Equity?

As it has been stated in the previous section, Digital equity is the social-justice goal of ensuring that everyone in our society has equal access to technology tools, computers and the Internet. Even more, it is when all individuals have the knowledge and skills to access and use technology tools, computers and the Internet. Digital equity can be defined as the state in which both the digital divide and the participation gap are both bridged. Digital equity ensures that everyone has equal opportunities to use the tools and resources needed to fully participate as a citizen in today's digitally-powered world. Lacking these opportunities causes people to encounter educational, economic and social limitations that negatively impact their quality of life.

Technology is so commonplace in our lives that it may be hard to believe there are still many people with limited access to and knowledge of the resources that are available online today. Children still stand in lines at libraries for a brief stint on a computer and parents have difficulty completing online employment applications; a clear and important difference between the new digital generation and the previous ones. While cell phones may have helped to close the gap to some degree, there are still important activities that are not well-suited for small mobile devices.

2.2 The Five Dimensions of Digital Equity

These dimensions have been chosen as fundamental categories by educators and professionals working in the field. If you are just beginning to learn about this field then these categories should help you address your basic needs:

- Access to technology resources (hardware, software, wiring and connectivity): possibility to have access to the technological resources allowing us to access the information existing in the network.
- Access to high quality digital content; if the information available in the network is not of good quality, people will not be attracted to access it.
- Access to high quality, culturally relevant content; the available information should not only be of high quality but adapted to the context in which each community is leaving.
- Educators skilled in using these resources effectively for teaching and learning; it Is obvious that for approaching the digital equity it is necessary to educate users but in

many environments there are not enough people with appropriate skills for learning end users in all the needed categories (e.g. basic user, advanced user, expert in installation and maintenance, hardware and software developer and builder, ICT research).
- Opportunities for learners and educators to create their own content; a way to increase the capacity of learners and educators is to offer them some tools to create contents accessible to the appropriate end users.

2.3 Digital Divide Impacts

It is difficult to have progress toward Digital Equity homogeneously in its five dimensions and, in consequence the risk to fall in Digital Divide exists, at least in someone of the five dimensions. How to avoid this inconvenient situation? What are the initial steps to progress toward Digital Equity?

- First it is necessary to allow that people can obtain the education allowing to conveniently using computers and networks in a large sense that is that users need to acquire a convenient knowledge for a correct use of computers and networks depending on the people desired education level: basic user, advanced user, expert in installation and maintenance, hardware and software developer and builder, ICT research, etc..
- And second people should be able to easily and deeply use both computers and networks for accessing and using all kind of information. Without infrastructure the other dimensions have no sense. But the investment in a new infrastructure has to be done only if the possibility of maintaining it is ensured; otherwise there is an important risk of wasting the funds of this investment.

In summary, the first steps to reach Digital Equity should be education and infrastructure. However the progress towards Digital Equity cannot be reached through individual efforts but by the coordinate effect of actions promoted by governments and governmental organizations. The global organizations to consider will be the International Telecommunication Union (ITU), the United Nations (UN) and the International Federation for Information Processing (IFIP).

3 Relation Between Digital Equity and the ITU-WSIS Action Lines

3.1 WSIS Action Lines

The Action Lines of the World Summit in Information Society (WSIS), proposed by the ITU are:

AL1. The role of public governance authorities and all stakeholders in the promotion of ICTs for development
AL2. Information and communication infrastructure

AL3. Access to information and knowledge
AL4. Capacity building
AL5. Building confidence and security in the use of ICTs
AL6. Enabling environment
AL7. ICT Applications: benefits in all aspects of life
    AL7.1 E-Government
    AL7.2 E-Business
    AL7.3 E-Learning
    AL7.4 E-Health
    AL7.5 E-Employment
    AL7.6 E-Environment
    AL7.7 E-Agriculture
    AL7.8 E-Science
AL8. Cultural diversity and identity, linguistic diversity and local content
AL9. Media
AL10. Ethical dimensions of the Information Society
AL11. International and regional cooperation.

3.2 Relation Between WSIS and Digital Equity

The action lines proposed by the ITU have as global goal the implementation of the Digital Equity in order to avoid the Digital Divide. The description of these Action Lines can be found in [2]. Maybe the idea of Digital Equity with respect to the WSIS Action Lines is not explicitly expressed, but after reading the documentation contained in [2], the conclusion is that Digital Equity should be considered as a transversal goal, common to all action lines. The goal of each one of these Action Lines works, in some way, to complete one or several dimensions of Digital Equity. Some examples of this fact are presented in the coming sections.

Example 1. Action Line 2: Information and Communication Infrastructure. The vision of this action line, as it is defined in [2], is: Infrastructure is the cornerstone in achieving goals such as digital inclusion, enabling universal, sustainable, ubiquitous and affordable access to ICTs by all, taking into account relevant experiences from developing countries and countries with economies in transition.

Digital Equity should be supported by a convenient infrastructure. So the infrastructure suggested in this Action Line has to be able to allow all citizens the correct access and use of ICT, covering one of the five dimensions of the Digital Equity.

Example 2: Action Line 3: Access to Information and Knowledge. The vision of this action line, as it is defined in [2], is: For the post-2015, it is envisioned inclusive information and knowledge societies to facilitate access and use of information and exchange of knowledge among all people, including those coming from previously marginalized groups and regions in addition to persons with impairments with a significant portion of knowledge flows and innovations that advance human rights and the attainment of development goals.

To succeed with the Digital Equity the government has to create and offer information and knowledge to all citizens or to establish the appropriate mechanisms allowing the creation and offering of information and knowledge accessible for all citizens. Otherwise there is the risk of provoking the Digital Divide between the citizens of the same country or between the citizens of the country with the citizens of other countries.

Example 3: Action Line 8: Cultural Diversity and Identity, Linguistic Diversity and Local Content. The vision of this action line, as it is defined in [2], is: The vision on inclusive Knowledge Societies is that of a more culturally and linguistically diverse digital world, where around 40 % of all existing languages are present in cyberspace and where development takes into account local, national and regional contexts, builds on the knowledge generated by all communities, promotes innovation and creativity, and allows all human beings to practice their own culture and enjoy that of others free from fear. It is a world where marginalized groups, including indigenous peoples, and those coming from migrations, diasporas and from language minorities, enjoy increased recognition and equity; artists, cultural professionals and practitioners are empowered to create, produce, disseminate enjoy and preserve a broad range of cultural goods, services and activities; and where intangible expressions inherited from past generations are kept alive for future generations.

If the global goal is to attain the Digital Equity it is necessary to respect the cultural diversity and identity giving the convenient importance to the linguistic diversity and local content. Otherwise there will be people without interest in accessing the information existing in the network and avoiding the attainment of the Digital Equity.

4 ITU-WSIS Action Lines and the UN Sustainable Development Goals

4.1 UN Sustainable Development Goals (SDG)

The recently defined by the United Nations Sustainable Development Goals are:

SDG1. End poverty in all its forms everywhere
SDG2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture
SDG3. Ensure healthy lives and promote well-being for all at all ages
SDG4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
SDG5. Achieve gender equality and empower all women and girls
SDG6. Ensure availability and sustainable management of water for all
SDG7. Ensure access to affordable, reliable, sustainable and modern energy for all
SDG8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
SDG9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG10. Reduce inequality within and among countries
SDG11. Make cities and human settlements inclusive, safe, resilient and sustainable
SDG12. Ensure sustainable consumption and production patterns
SDG13. Take urgent action to combat climate change and its impacts
SDG14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
SDG15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
SDG16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
SDG17. Strengthen the means of implementation and revitalize the global partnership for sustainable development

Each one of these goals is divided in [3] in a number of sub-goals (83) whose analysis allows a better understanding with respect to WSIS ALs and to the IFIP TCs.

4.2 Relations Between the UN SDG and the WSIS Action Lines

WSIS has prepared a matrix indicating the effect of each one of the Action Lines on the different Sustainable Development Goals [5]. Table 1 presents these relations.

Table 1. Effect of each one of the Action Lines on the SDG

Sustainable Development Goal	WSIS Action Lines
1. End poverty in all its forms everywhere	AL1, AL2, AL3, AL4, AL5, AL7.2, AL7.4, AL7.7, AL7.8, AL10
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture	AL3, AL4, AL6, AL7.2, AL7.4, AL7.7, AL8, AL10
3. Ensure healthy lives and promote well-being for all at all ages	AL1, AL3, AL4, AL7.4, AL7.7, AL8, AL10
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	AL3, AL4, AL5, AL6, AL7.3, AL7.5, AL7.7, AL8, AL10
5. Achieve gender equality and empower all women and girls	AL1, AL3, AL4, AL5, AL6, AL7.2, AL7.4, AL7.7, AL9, AL10
6. Ensure availability and sustainable management of water and sanitation for all	AL3, AL4, AL7.8, AL8
7. Ensure access to affordable, reliable, sustainable and modern energy for all	AL3, AL5, AL7.8
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	AL2, AL3, AL5, AL6, AL7.5, AL7.7, AL8, AL10

(*Continued*)

Table 1. (*Continued*)

Sustainable Development Goal	WSIS Action Lines
9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	AL2, AL3, AL5, AL6, AL7.1, AL7.2, AL7.6, AL7.7, AL9, AL10
10. Reduce inequality within and among countries	AL1, AL3, AL6, AL7.5, AL10
11. Make cities and human settlements inclusive, safe, resilient and sustainable	AL2, AL3, AL5, AL6, AL7.6, AL8, AL10
12. Ensure sustainable consumption and production patterns	AL3, AL4, AL7.5, AL7.7, AL8, AL9, AL10
13. Take urgent action to combat climate change and its impacts	AL3, AL4, AL7.6, AL7.7, AL7.8, AL10
14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development	AL3, AL4, AL7.6, AL7.8
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	AL3, AL7.6, AL7.8
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	AL1, AL3, AL4, AL5, AL6, AL7.1, AL9, AL10
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development	AL1, AL3, AL4, AL5, AL6, AL7.1, AL7.2, AL7.4, AL7.5, AL7.7, AL7.8, AL9, AL10, AL11

If all WSIS Action Lines have some impact in the UN SDGs, the actions conducting to the Digital Equity will contribute at some level to approach the UN SDGs. So we can say that Digital Equity establishes the UN SDG in the specific domain of ICT that is WSIS Action Lines represent the application of SDG in the ICT domain. In some sense the dimensions of Digital Equity are included in one or several SDG and actions going toward Digital Equity contribute to the UN SDGs.

5 Digital Equity in Different Groups or Environments

Is Digital Equity in identical situation in all countries? Is Digital Equity in identical situation for the different genders?

It would be interesting to see the situation of Digital Equity with respect to different criteria like developed versus developing countries, like gender issue, etc. but let us concentrate in this article in the differences between developed and developing countries.

5.1 Situation of Digital Equity in Developed and Developing Countries

Digital Equity is neither yet reached in developed nor in developing countries. However the level of Digital Equity is quite different in developed and in developing countries. We can analyze these differences comparing the state of the five dimensions of Digital Equity in both types of countries.

- Access to technology resources (hardware, software, wiring and connectivity): possibility to have access to the technological resources allowing us to access the information existing in the network: Obviously the situation of the technological resources in developed countries is more comfortable than in developing ones, mainly because the extension of the network coverage and its capacity in developed countries are much more higher, faster and reliable than in developing ones. Also because the availability of devices in developed countries is greater, with higher novelty of models and at prices economically cheaper taking into account the economic level of the country. And finally the possibility for the end users of receiving the appropriate education is also higher; and this is true at all levels of education: basic user, advanced user, expert in installation and maintenance, hardware and software developer and builder, ICT research, etc.; it is easy to find the necessary education at reasonable prices for all type of education. Also in many countries there are strong differences in the access possibilities for the different genders.
- Access to high quality digital content; if the information available in the network is not of good quality, people will not be attracted to access it. Developed countries have an infrastructure allowing the access to all information existing in Internet by both the quality of the physical connection and the freedom for accessing all kind of information. Developing countries can have limitations by one or both of these aspects; in some cases the network has not enough capacity for accessing heavy information, and in other cases the access is limited by political reasons.
- Access to high quality, culturally relevant content; the available information should not only be of high quality but adapted to the context in which each community is living. Most of the web pages are written in English (or at least is the greatest minority) making difficult the access of people not fluent in reading this language. Also the topics contained in these pages are thought with Anglo-Saxon parameters making the access by people of other cultures of low interest. Consequence: not all pages are equally interesting for all people in the world, increasing the disadvantages of people of developing countries.
- Educators skilled in using these resources for effectively teaching and learning; it Is obvious that for approaching the digital equity it is necessary to educate users but in many environments there are not enough people with appropriate skills for learning end users in all the needed categories. Education is a key point for reaching Digital Equity. However to deliver education it is necessary to have educators of all the needed profiles. The number and quality of the education centres dedicated to the educators are higher in developed than in developing countries.

- Opportunities for learners and educators to create their own content; a way to increase the capacity of learners and educators is to offer them some tool to create contents accessible to the appropriate end users. The hardware and software infrastructure is much more solid in developed than in developing countries.

5.2 Contribution of IFIP to Digital Equity

The International Federation for Information Processing is a society created in 1960 under the auspices of UNESCO grouping computer societies under the base of one member society per country. From the technical point of view IFIP is composed of a number of Technical Committees (TC) each one dedicated to a specific aspect of computer science, engineering and applications. Each TC is composed of a number of Working Groups (WG), each one devoted to a specific aspect of the TC domain. Currently there are 13 TCs and 120 WGs grouping thousands of computer professionals.

IFIP has decided that Digital Equity is one of its Strategic Activity Lines. In general we can consider that the work of all these bodies contribute to the Digital Equity. However there are some of them are more specifically oriented to tackle the Digital Divide and empowering Digital Equity.

From the previous introduction let us review the different TCs and analyze what is their involvement in some aspect of the Digital Equity. The IFIP TCs are:

- TC1 on Foundations of Computer Science, whose aims are: to support the development of theoretical computer science as a fundamental science; and to support the development and exploration of fundamental concepts, models, theories, systems, and and the understanding of laws, limits, and possibilities of information processing. Its influence on Digital Equity is generic but not directly implied.
- TC2 on Software, Theory and Practice, whose aim is to obtain a deeper understanding of programming concepts in order to improve the quality of software by studying all aspects of the software development process, both theoretical and practical. So, building good software products has a positive influence on Digital Equity mainly promoting good practices in the creation of software products.
- TC3 on Education whose aims are: to provide an international forum for educators to discuss research and practice in: teaching informatics; and educational uses of communication and information technologies (ICT); to establish models for informatics curricula, training programs, and teaching methodologies; to consider the relationship of informatics in other curriculum areas; to promote the ongoing education of ICT professionals and those in the workforce whose employment involves the use of information and communication technologies; to examine the impact of information and communication technologies on the whole educational environment: teaching and learning; administration and management of the educational enterprise; and local, national and regional policy-making and collaboration. As education is a key factor for reaching Digital Equity, we can see that the aims of this TC are fully in line with the dimensions of Digital Equity.
- TC5 on Information Technology Applications whose aim is to promote research and development of fundamental concepts, models, and theories to support

applications of ICT. So, it has a generic interest for Digital Equity; only the promotion of applications appropriate for developing countries can help to attain Digital Equity.

- TC6 on Communication Systems, whose aims are to promote the international exchange of information related to communication systems; to bridge gaps existing between users, telecommunication operators, service providers and computer and equipment manufacturers; and to establish working contacts with international bodies concerned with data communication, such as ITU, ETSI, ISO, IEEE, IETF, ITC and ATM Forum. The aims of this TC are fully in line with a dimension of the Digital Equity (creation of a convenient infrastructure). In particular in this TC there is a WG devoted to developing countries so dedicated to bridge the gap between developed and developing countries with respect to Digital Equity. This is the WG6.9 on Communications Systems for Developing Countries, whose aims are: to identify and study technical problems related to the access to, understanding of and application of network and telecommunications technology in developing countries or regions; to encourage cross-fertilization of concepts and techniques among developing countries, and between developing countries and developed countries; to promote activities oriented to the diffusion of the methods and techniques for accessing computer networks in developing countries or regions.
- TC7 on System Modelling and Optimization, whose aims are: to provide an international clearing house for computational (as well as related theoretical) aspects of optimization problems; to promote the development of necessary theory to meet the needs of complex optimization problems and cooperate with the International Mathematics Union; and to foster interdisciplinary activity on optimization problems spanning the areas such as Economics, Biomedicine, Meteorology, etc., in cooperation with associated international bodies. So, it has not a specific interest for Digital Equity.
- TC8 on Information Systems whose aim is to promote and encourage interactions among professionals from practice and research and advancement of investigation of concepts, methods, techniques, tools, and issues related to information systems in organizations. So, it has a generic interest for Digital Equity specially proposing good practices for the information systems.
- TC9 on ICT and Society whose aims are: to develop understanding of how ICT progress is associated with change in society; and to influence the shaping of socially responsible and ethical policies and professional practices.

  The aims of this TC are fully in line with several dimensions of the Digital Equity. In particular it has a WG devoted to Developing countries dedicated to bridge the gap between developed and developing countries. It is the WG9.4 on Social Implications of Computers in Developing Countries, whose aims are: to collect, exchange and disseminate experiences of ICT implementation in developing countries; to develop a consciousness amongst professionals, policy makers and public on social implications of ICT in developing nations; to develop criteria, theory, methods, and guidelines for design and implementation of culturally adapted information systems; and to create a greater interest in professionals from industrialized countries to focus on issues of special relevance to developing countries.

- TC10 on Computer Systems Technology, whose aim is the promotion of the State-of-the-Art and the coordination of information exchange on concepts, methodologies, and tools in the stages in the life cycle of computer systems. So, it has a generic but not specific interest for Digital Equity.
- TC11 on Security and Privacy Protection in Information Processing Systems whose aim is to increase the trustworthiness and general confidence in information processing and to act as a forum for security and privacy protection experts and others professionally active in the field. Obviously the topics concerned by this TC are of high importance for reaching Digital Equity, ensuring the needed security and privacy protection to the information and to the end users.
- TC12 on Artificial Intelligence whose aims are: to foster the development and understanding of Artificial Intelligence and its applications worldwide; to promote interdisciplinary exchanges between Artificial Intelligence and other fields of information processing; and to contribute to the overall aims and objectives and further development of IFIP as the international body for Information Processing. The aims of this TC are not of specific interest for Digital Equity.
- TC13 on Human-Computer Interaction whose aims are: to encourage empirical research (using valid and reliable methodology, with studies of the methods themselves where necessary); to promote the use of knowledge and methods from the human sciences in both design and evaluation of computer systems; to promote better understanding of the relation between formal design methods and system usability and acceptability; to develop guidelines, models and methods by which designers may be able to provide better human-oriented computer systems; and to co-operate with other groups, inside and outside IFIP, so as to promote user-orientation and "humani-zation" in system design. Obviously the topics concerned by this TC are important for reaching Digital Equity, because a good interface to the searched information helps a lot to its usability by the end users.
- TC14 on Entertainment Computing whose aims are: to enhance algorithmic research on board and card games; to promote a new type of entertainment using information technologies; to encourage hardware technology research and development to facilitate implementing entertainment systems; and to encourage non-traditional human interface technologies for entertainment. Maybe the topics concerned by this TC are marginal for reaching Digital Equity, but it works on topics making the access to information more attractive to the end users.

So IFIP has convenient bodies to tackle the problems derived from and related to Digital Equity in general and specifically in developing countries. The recent creation of a Standing Committee in Digital Equity will increase and coordinate the action to promote the Digital Equity.

6 Conclusions

We have analyzed the concept of Digital Equity and the different aspect it includes. Also we have seen how several international organizations; the Action Lines of the World Summit in Information Society, the United Nations Sustainable Development

Goals and the Technical Committees of the International Federation for Information Processing have a strong overlapping with the goals proposed by Digital Equity. Maybe these international organizations have not an exact coincidence on their goals, but an important overlap between them has been clearly stated.

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