

# ICT USAGE IN MODERN DAY TOWN PLANNING: CHALLENGES AND PROSPECTS

TPL. Adeniyi, Joshua Olu<sup>1</sup>, Ezekiel Ufuoma Lucky<sup>2</sup>

<sup>1</sup>Department of Urban and Regional Planning, Rufus Giwa Polytechnic, Owo Nigeria

<sup>2</sup>Department of Urban and Regional Planning, Rufus Giwa Polytechnic, Owo Nigeria

DOI: <https://doi.org/10.5281/zenodo.7990551>

Published Date: 31-May-2023

---

**Abstract:** We live in an era of rapid change moving towards the information/knowledge/network society and ICT is the major drive towards achieving this goal and the use of ICT in urban and regional planning is a new perspective which is posing great challenge to the planning practitioners and students in the various planning institutions. This paper therefore looks at ICT usage in modern day planning, its challenges and the way forward. The study adopted the literature review method in which relevant literatures was used to get the necessary information for the study. The study suggested therefore that Town planners especially lecturers should get themselves abreast with the new ICT technology so as not to be left out, schools and institutions should grasp the opportunity to inculcate ICT technology into their curriculum and the necessary infrastructures should be provided by the institutions to enhance ICT based learning even in the classrooms learning the ICT skills so as to stand out in this growing technology and also to have smart cities and smart innovations.

**Keywords:** Information and Communication Technology (ICT); Planning Education; Software; Urban Planning.

---

## 1. INTRODUCTION

We live in an era of rapid change moving towards the information / knowledge / network society. One of the driving forces of this development is the new information and communication technology, ICT (Juha, 2003). The impacts of ICT have often been compared to the transformations of society brought by the Industrial Revolution (Da-Mi and Zorica, 2008). This technology has progressed rapidly during the last 20 years and the pace of development of new tools and applications is intense (Juha, 2003). The use of ICT in Nigeria today is fast becoming multifaceted. Every profession has found a use for ICT in carrying out various functions in their organization, and planning is no different.

It is clear that any effort towards propagating knowledge to increase the level of self-awareness in the communities must carefully consider the tools that convey these ideas (De Fillipi and Balbo, 2011). ICTs are making dynamic changes in society. They are influencing all aspects of life. The influences are felt more and more at schools. Because ICTs provide both students and teachers with more opportunities in adapting learning and teaching to individual needs, society is, forcing schools aptly respond to this technical innovation (Fiseha, 2011).

There is a correlation between planning and computer (Abdullahi, 2014). The ongoing ICT evolution reshapes and regroups traditional cities and transforms their social and economic bases enormously. The use of ICT in town planning has come to stay. From the school to the office and even to spatial planning, ICT has become an indispensable tool, which has aided planners in so many ways. Abdullahi (2014) in supporting the claim stated there as two main interesting areas of the use of computers in planning; the first is the software of relevance to planning while the other is the area it has been successfully used.

Contemporary planning practice deals with the orderly arrangement of various land uses and human activities in space. It involves allocating land for various uses and also carrying out necessary proposals for these plans to be fully effective. These proposals are not deficit of various analysis as well as project planning and management and other relevant aspects that involves proper planning. The crux of the issue however lies in the use of ICT for carrying out the above listed.

The impact of the development of the information society and especially the impact of ICT on the structures of cities and regions and on spatial development and planning in general is thus now a question which should be widely discussed by planners. Until now this discussion has been modest. One reason for this is probably simply the fact, as Moss (2000) argues, that we do not understand how these technologies will shape the growth of cities and regions. This is understandable. Modern information and communication technology is a newcomer and the application of this technology is still in the early stages, although rapidly increasing (Juha, 2003).

Most town planners in Nigeria are bedeviled by their lack of knowledge in the use of ICT for carrying out various activities, thus they result to the use of manual instruments which they claim they are used to. This is also evident in most of the planning institutions where we find most of the acclaimed town planners as non ICT literates, as most of them believe they have no time to learn the relevant software and tools needed since they have passed the ICT age. This becomes a major problem in the field of endeavour as young planners are venturing into the aspect of ICT while the tutors remain in the dark. Thus, it becomes necessary to have a look at the use of ICT for contemporary planning in Nigeria.

## **2. URBAN PLANNING IN THE 21<sup>ST</sup> CENTURY**

Although in recent years considerable research has examined the influence of ICT on urban form, a significant gap is the lack of attention to the linkages between ICT and urban planning. That shortcoming may have several reasons, including the relatively short history of ICT and also their rapid changes as ICT is still a new technology when it comes to urban planning especially in the third world countries like Nigeria. Fast changes of ICT and their impact on different aspects of society prevent urban planning from dealing with the interaction between cities and ICT. The urban planning's incapability to track these changes results in speculation by planning academics and professionals and a risk for them to assume technologically deterministic views (Firmino, 2008).

Moreover, urban planning may have been hampered in monitoring the changing technological landscapes and addressing the resulting issues in a timely manner (Da-Mi and Zorica, 2008). Unlike traditional urban physical infrastructure, most ICT infrastructure is invisible to the public, being composed of underground networks of cables and fiber optics, and satellite-based telecommunications (Graham and Marvin, 1996). Batty (1990) also makes the observation that "cities are becoming invisible to us and this invisibility is increasing faster than our ability to adapt our research methods to these new circumstances" (p. 130). Since traditional urban planning has heavily depended on visible and tangible space, urban scholars and planners find the invisible and intangible characteristics of ICT difficult to handle (Firmino, 2008). In addition to its invisibility, ICT infrastructure is highly complex.

ICT infrastructure is built primarily by the private sector and simply protected by federal and state regulations, whereas traditional infrastructure is usually owned by the public sector (Moss, 1998). That divergence in ownership has kept public sector and planning in particular from participation in ICT infrastructure, and has obscured recognition of how ICT infrastructure can affect development in their community (Bradbury and Becker, 1995).

Finally, the lack of useful theoretical and conceptual frameworks for study of ICT and urban planning is also a challenge. Graham and Marvin (1996) note that many urban planning professionals and scholars still view urban form in a traditional framework, overlooking the actual dynamics of ICT and urban form – in short, paradigm challenge occurs (Da-Mi and Zorica, 2008). The general problem have to do with the fact that ICT was unavailable in the period of their learning, therefore meeting up with the present challenge of ICT in present time becomes difficult, thus resulting to the use of traditional tools for planning, and this method is fast phasing out. Changes in the concepts and approaches of urban planning are required to match technological advances and their impact; however the importance of urban planning need to be refocused to provide insight on the challenges that urban planning faces, some studies focus on such specific issues as planning responses to the land use changes associated with ICT. Dealing with the new types of land uses (e.g., business and industrial parks and telework centers) and ICT infrastructure requires changes in planning mechanisms and strategies, including revising zoning ordinances or streamlining the development review process.

Gillespie (2002) also notes that planners need to “develop awareness” of the influence of the urban development in the Information Age. The importance of ICT is currently recognized in terms of their applications that can enhance planning tools such as the AutoCAD, SPSS, GIS software among others.

### **3. ICT AND SMART CITIES**

Urban planning ICTs can promote better informed decision making by providing planners with appropriate, up to-date and actionable intelligence. This could improve the efficiency, operation and transparency of physical infrastructure, roads, water, wastewater, emergency and other services. For the collection of data, urban sensors and advanced analytics have the potential of providing city leaders within different departments with access to a rich range of real-time spatial and environmental information about their cities. ICTs also offer new and improved ways of ensuring citizen participation in planning decisions, for example through the use of e-consultations and other e-channels (UN-Habitat, 2015).

### **4. THE BENEFITS OF ICT IN PLANNING EDUCATION**

The uses of ICT is making major differences in the learning of students and teaching approaches (Fisseha, 2011). Schools in the Western World invested a lot for ICT infrastructures over the last 20 years, and students use computers more often and for a much larger range of applications (Volman, 2005). Several studies reveal that students using ICT facilities mostly show higher learning gains than those who do not use. ICT aspects include e-learning, virtual learning, use of various ICT software among others.

E-learning is being increasingly adopted by municipal education systems to enhance learning. It generally refers to the use of technology as classroom aids, although over time, there has been a gradual increase in fully online learning. Computer-supported collaborative learning is one of the most promising innovations to improve teaching and learning with the help of modern information and communication technology. It focuses on collaborative or group learning whereby instructional methods are designed to encourage students to work together on learning tasks (Warren Karlenzig, 2011).

Online courses allow students to proceed at their own pace. If they need to listen to a lecture a second time, or think about a question for a while, they may do so without fearing that they will hold back the rest of the class. Through online courses, students can earn their diplomas more quickly, or repeat failed courses without the embarrassment of being in a class with younger students. Students also have access to an incredible variety of enrichment courses in online learning, and can participate in college courses, internships, sports, or work and still graduate with their class.

Virtual classrooms can often use a mix of information and communication technologies. Participants in a virtual classroom can use emoticons to communicate feelings and responses to questions or statements; they can 'write on the board' and even share their desktop. Other communication technologies available in a virtual classroom include text notes, microphone rights, and breakout sessions. Breakout sessions allow the participants to work collaboratively in a small group setting to accomplish a task, as well as allow the teacher to have private conversations with individual students.

In addition to virtual classroom environments, social networks have become an important part of e-learning. Social networks have been used to foster online learning communities around various subjects. Mobiles, such as handheld computers and cell phones, can be used to assist in such things as language learning. It is generally considered that schools have not caught up with the latest social networking trends.

With the advent of ICT in planning, the learning style automatically is put at a better stance, as it contributes to a more constructivist learning and an increase in activity and greater responsibility of students (Volman, 2005; Fisseha, 2011). It aids the teacher in supporting, advising and coaching students instead of just telling them orally or verbally an item. With the ICT introduction to schools, the theoretical ideas are tested and seen in practice and pictorial form, and with the use of imagery and videos, teaching as well as learning becomes a thing of interest, for instance showing students how a garden city looks like on slides and projector, the students have a mental imagery of what it looks like and when they are applying this in the future, the imagery reflects and stimulates in their practical jobs, and this is because mental imagery of pictures especially those related to ICT are always reflective in imagination when they are to be put to use.

On the other hand, teachers' reluctance to adopt innovations need to be seen in the context of existing technology and commitments. Watson (2001) states that change or improvement can happen at schools if teachers understand themselves and understood by others. For instance, many teachers are currently not in a position to make informed judgements on ICTs

to support their teaching goals. Clearly a variety of factors still do make using ICT in the curriculum problematic. Because of this, the influence of ICT did not bring revolutionary changes at schools. For instance, in most of the planning schools and departments, there are so many lecturers who do not use ICT at all and this is because of the fact that they are not knowledgeable in the aspect or that they fear the method would not be.

In recent years however, there has been a growing interest to know how computers and internet can best utilized to improve effectiveness and efficiency of education at all levels and in both formal and non-formal settings (Fisseha, 2011). As there is a shift of theories explaining learning processes, ICTs become handmaiden for learning activities, their contribution to changes in teaching practices, school innovation, and community services is considerable. A research review by Kozma (2005) suggests three significant concerns of consideration regarding ICTs impact on education. Firstly, student outcomes such as higher scores in school subjects or the learning of entirely new skills needed for a developing economy. Secondly, we should consider teacher and classroom outcomes such as development of teachers' technology skills and knowledge of new teaching methods as well as improved attitudes toward teaching. Finally, one has to consider other outcomes such as increased innovativeness in schools and access of community members to adult education and literacy (Fisseha, 2011).

An improvement in the curriculum as well as addition of relevant ICT knowledge to it, gives future planners a better chance to compete in the market, as this gives them a better base to carry out their functions effectively and also helps to improve their performance than their counterparts in other allied disciplines. Also it places the planners at a better angle to carry out their functions with ease especially in this time when the world is going in terms of ICT.

## 5. LIMITATIONS OF ICT USE IN PLANNING EDUCATION

ICT as a modern technology that simplifies and facilitates human activities is not only advantageous in many respects, but also has many limitations. Many people from inside and outside the education system, think of ICT as "Panacea" or the most important solution to school problems and improvements. However, many conditions can be considered as limitations of ICT use in education. The limitations can be categorized as teacher related, student related, and technology related. All of them potentially limit the benefits of ICT to education (Fisseha, 2011).

### i. Teachers' / Lecturers' Attitude

This plays an important role in the teaching-learning process that utilizes computers and internet connections. Although teachers' attitude towards use of these technologies is vital, many observations reveal that most teachers do not have clarity about how far technology can be beneficial for the facilitation and enhancement of learning. Of course, some teachers may have positive attitudes to the technology, but refrain from using it in teaching due to low self-efficacy, tendency to consider themselves not qualified to teach with technology as in the case of most of the old town planning lecturers who did not have the use of ICT in their time as a result, teaching or using ICT technology to teach becomes difficult, as they feel unqualified in most cases to teach these technologies owing to their limited knowledge in the area. Moreover, as identified by Brosnan (2001), attitude, motivation, computer anxiety, and computer self-efficacy are factors affecting teachers' use of computers in their lessons. Teacher resistance and lack of enthusiasm to use ICT in education may also be another limitation.

Furthermore, many teachers may not have the required IT skills and feel uncomfortable, nor do they have trainings needed to use the technology in their teaching. Unless teachers develop some basic skills and willingness to experiment with students, ICT use in education is in a disadvantage (Brosnan, 2001; Fisseha, 2011).

### ii. Students Behaviour

On the other hand, the limitation of ICT use in education is related to student behaviour. Appropriate use of computer and the internet by students have significant positive effects on students' attitude and their achievement. Nonetheless, it is very common to observe limitations related to student behaviour. Students tend to misuse the technology for leisure time activities and have less time to learn and study. Yousef and Dahmani (2008) described online gaming, use of face book, chat rooms, and other communication channels as perceived drawbacks of ICT use in education, because, students easily switch to these sites at the expense of their study. Internet access at home, for instance, may be a distraction because of chat rooms and online games, reducing the time spent in doing assignments and learning (Kulik, 1994). Therefore, the impact of availability of ICT on student learning strongly depends on its specific uses.

If ICT is not properly used, the disadvantage will outweigh the advantage. For example, while students use the internet, it may confuse them by the multiplicity of information to choose from. As a result, the teacher spends much time to control students from websites unrelated to the learning content. Then, for caution, it is important to identify the major limitations of ICT use in education as related to student behaviour.

Fisseha (2011) in identifying the limitations of ICT use in education as related to student behaviour gave the following limitations.

- Computers limit students' imaginations,
- Over-reliance on ICT limits students' critical thinking and analytical skills,
- Students often have only a superficial understanding of the information they download,
- Computer-based learning has negative physical side-effects such as vision problem,
- Students may be easily distracted from their learning and may visit unwanted sites,
- Students tend to neglect learning resources other than the computer and internet,
- Students tend to focus on superficial presentations and copying from the internet,
- Students may have less opportunity to use oral skills and hand writing,
- Use of ICT may be difficult for weaker students, because they may have problems with working independently and may need more support from the teacher.

These challenges however do not limit the importance of ICT in learning because the advantage is still greater than the disadvantage it poses.

### iii. Technology.

Fisseha (2011) in listing the problem stated that the high cost of the technology and maintenance of the facilities, high cost of spare parts, virus attack of software and the computer, interruptions of internet connections, and poor supply of electric power are among the technology related limitations of ICT use in education.

### iv. Shortage of ICTs facilities and ICTs skills

Another major challenge facing the development of ICT in planning education is the shortage of ICT facilities such as computers, constant power supply, planning software and other needed facilities to carry out effective learning. Also the problem of the lack of ICT skills by the tutors and teachers in the various institutions poses great challenge to the development of the ICT in these schools. In fact, one impeding factor of ICTs integration in education systems is the skill gap of people implementing it (Tinio, 2002). Due to the lack of knowledge in the use of the ICT by the teachers, they neglect the aspect and try to teach abstractly with the little knowledge they have of ICT without practical base which is ought to form the foundation of proper ICT practice. For instance, teachers need professional development to gain skills with particular applications of ICT, integration into existing curricula, curricular changes related to its use, changes in teacher role, and on underpinning educational theories such as constructivism/or student-centred learning. Because of this, any attempt of ICT integration in education should parallel with teachers professional development (Fisseha, 2011).

### v. Limited financial resources

Another great challenge is the financing. Limited financial resources for sponsoring ICT based teachings and also providing the necessary infrastructures for ICT development is often a problem. This is predominant especially in our Nigeria setting where most institutions prefer to spend money on building infrastructures than ICT based development, especially with the general believe that computers are consumable items which do not last long, thus the little capitals are spent on hard infrastructures than ICT infrastructures.

ICTs in education programs require large capital investment and developing countries need to predict the benefit of ICT use to balance the cost relative to the existing alternatives. Potential sources of money and resources for ICT use programs suggested are grants, public subsidies, fund-raising events, in kind support from volunteers, community support, revenues



earned from core business, and revenues earned from ancillary activities (Tinio, 2002). Overcoming the mentioned challenges may help planning education benefit the most from this technology.

#### **vi. Inadequate communications and power infrastructure**

Lack of proper communication as well as lack of power infrastructure (constant power supply) is one of the major challenge hindering the growth of ICT in Nigeria planning institutions. The lack of constant power supply has been a pain in the neck especially when this power is only available few hours of the day and unreliable, making the users to spend money unnecessarily on the provision of alternative power source resulting from the use of generating sets (which cause pollution to the environment) and other power channels for power supply.

#### **vii. Lack of proper data**

Proper data for taking ICT based courses in the institutions has always been a challenge, as the course allocation in most cases do not carry all that is needed by the students to carryout effective planning in the various planning schools. ICT-enhanced education requires clearly stated objectives, mobilization of resources and political commitment of the concerned bodies. Lack of proper teaching aid to help ICT lecturers effectively carry out their duties are lacking as a result, they teach what they feel is important for the students leaving out the vital and necessary details the students are supposed to be abridge with. It is wise to specify educational goals at different education and training levels as well as the different modalities of ICT use that can facilitate in the pursuit of the goals (Fisseha, 2011).

#### **viii. Inadequate public private partnership**

Lack of public private partnership in ICT based learning and infrastructure provision is also another major challenge facing the development of ICT education in planning institutions. Proper public-private partnership is needed to carry out effective ICT based learning especially where the private firms/individuals provide the necessary skills/information needed to carry out effective planning and the public providing relevant infrastructures.

#### **ix. Lack of basic infrastructures**

The infrastructure challenges that may exist are absence of appropriate buildings and rooms to house the technology, shortage of electric supply and telephone lines, and lack of the different types of ICTs. Because of this, one need to deal with infrastructure related challenges before the planning of ICTs integration to education systems.

#### **x. Learning content and language**

Furthermore, learning content and language also challenge the integration of ICT in education. Content development is a critical area that educators overlook. In integrating ICT in education, we have to care for the relevance of the learning content to the target groups. With respect to language, English is the dominant language in many of educational software, while English language proficiency is not high in many of the developing countries, and this is one barrier in the integration of ICT to education.

## **6. RECOMMENDATION**

Considering the above challenges and the subject of discussion, the following recommendations are given.

- i. Town planners especially lecturers should get themselves abreast with the new ICT technology so as not to be left out.
- ii. Schools and institutions should grasp the opportunity to inculcate ICT technology into their curriculum.
- iii. ICT can help to produce better planning methods and smart cities, thus it should be taken seriously especially by students of planning as well as practitioners in the field.
- iv. The use of manual designs and activities should be limited especially in planning institutions and the use of ICT for carrying out designs as well as other activities should be encouraged.
- v. The use of manual maps should be stopped as the use of digital mapping system with GIS tools should be encouraged especially in relation to land use planning.
- vi. The necessary infrastructures should be provided by the institutions to enhance ICT based learning even in the classrooms.

- vii. The provision of laptops and other gadgets should be provided by planning institutions at the entrance to these schools, as this should be included into the students' tuition fees at the inception of these students.
- viii. The curriculum should be improved on and the necessary details needed for students to excel should be introduced into the curriculum.
- ix. New software which can help to move the profession forward should be introduced and we should not just rely on the existing software alone for effective planning.
- x. Compulsory assignments and other projects should be given to students at all times to encourage the usage of the ICT infrastructures.

## 7. CONCLUSION

The use of ICT especially in this 21<sup>st</sup> century is a must for every sphere of human development and the planners are not excluded to this fact. Planners must know that the system is changing and we need to change and evolve with it also, we need to start learning the ICT skills so as to stand out in this fast growing technology and also to have smart cities and smart innovations. The time of relying on manual methods is fast declining. Hence, there is the need to embrace ICT in our various endeavours then the sky becomes the starting point.

**Acknowledgement:** We want to acknowledge the suggestions, advice and contributions of both senior colleagues, professional colleagues and supporting staff on this research work. These people of honor include Tpl. Omosulu, S.B; Tpl. Dr. Olugbamila, O.B; Tpl. Dr. A.A. Emmanuel; Tpl. Olufayo Olusola; Tpl. Dr. Dare Olamiju, Mr. James Arinbola; QS. Akinmusire; Arch. Deacon Olabintan; Tpl. O. Yinyegha, Daodu Hope; Adedayo Ezekiel, among others.

## REFERENCES

- [1] Abdullahi, R.B (2014). *Introduction to Urban and Regional Planning Practice in Nigeria*, Omo-Sa-aja Prints, Birnin Kebbi, Kebbi state.
- [2] Batty, M. (1990b) Invisible cities, *Environment and Planning B: Planning and Design*, 17, pp. 127-130.
- [3] Bradbury, S. L. and Becker B. (1995) Infrastructure of the "New Age": telecommunications planning, *Journal of Planning Literature*, 10(2), pp. 142-153.
- [4] Brosnan, T. (2001). *Teaching Using ICT*. University of London: Institute of Education.
- [5] Da-Mi M. and Zorica N. B. (2008). Urban Form and Planning in the Information Age: Lessons from Literature
- [6] De Filippi, F and Balbo, R (2011). Planning for real: ICT as a tool in urban regeneration, *The Built & Human Environment Review*, Volume 4, Special Issue 1, available at: <http://usir.salford.ac.uk/18534/>
- [7] Firmino, R. J. (2008) (Re)thinking urban planning: Urban-technology and planning in medium-sized cities in São Paulo, in: T. Yigitcanlar, K. Velibeyoglu and S. Baum (Eds) *Creative Urban Regions: Harnessing Urban Technologies to Support Knowledge City Initiatives*. Hershey, PA.: IGI Global. (forthcoming)
- [8] Fisseha M. (2011). The Roles of Information Communication Technologies in Education Review Article with Emphasis to the Computer and Internet, *Ethiop. J. Educ. & Sc.* Vol. 6 No 2
- [9] Gillespie, A. (2002) Digital lifestyles and the future city, in: N. Leach (Ed.) *Designing for a Digital World*. Chichester: John Wiley & Sons.
- [10] Graham, S. & Marvin, S. (1996). *Telecommunications and the City. Electronic spaces, urban places*. London: Routledge.
- [11] Juha T (2003). The Impact of Information and Communication Technology on Urban and Regional Planning, Helsinki University of Technology Institute of Real Estate Studies
- [12] Kulik, J.A. (1994). Meta-analytic studies of findings on computer-based instruction. In J.E.L. Baker & H.F.O' Neil (Ed.), *Technology Assessment in Education and Training*. Hillsdale, NJ: Lawrence Erlbaum

- [13] Kundishor, S.M. (2009). *The Role of Information and Communication Technology (ICT) in Enhancing Local Economic Development and Poverty Reduction*, Zimbabwe Academic and Research Network, Zimbabwe
- [14] Kozma, R.B, (2005). National policies that connect ICT-based education reform to economic and social development. *An interdisciplinary journal of humans in ICT environment* 1(2) 117-156
- [15] Ministry of Industry and Information Technology of PRC Executive Committee (2010). *ICT and Urban Development*, Shanghai China International Telecommunication Union (ITU) Ningbo Municipal Government
- [16] Moss, M.L. (2000). Why Cities Will Thrive in the Information Age. *ULI on the Future: Cities in the 21st Century*. Washington, DC: Urban Land Institute.
- [17] Tinio, V.L. (2002). ICT in Education: UN Development Programme. (Retrieved from <https://www.eprmers.org> on July 2018)
- [18] UN-Habitat (2015). The Role of ICT in the Proposed Urban Sustainable Development Goal and the New Urban Agenda
- [19] Volman M. (2005). Variety of roles for a new type of teacher. *Educational technology and the teacher profession*. *Teacher and Teacher Education*, 21, 15-31.
- [20] Warren K. (2011). Chapter 8 – Using Information and Communication Technologies for Smart and Connected Cities, *Shanghai Manual – A Guide for Sustainable Urban Development in the 21st Century*
- [21] Watson, D.M. (2001). Pedagogy before Technology: Re-thinking the Relationship between ICT and Teaching. *Education and Information Technologies*, 6, 4, 251-266
- [22] Yousef, A. B. and Dahamini, M. (2008). The Economics of E- Learning: The Impact of ICT on Student Performance in Higher Education: Direct Effects, Indirect Effects and Organizational Change (<http://rusc.uoc.edu>, downloaded July 7, 2018)