A new educational pattern in response to new technologies and sustainable development. Enlightening ICT skills for youth employability in the European Union

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Abstract

The so-called fourth revolution is underway and its impact is appreciated in societies and in the way of life of people, particularly due to its effects on the labor market. The disruption generated by the fast changes point out to the immediacy of the needed changes in higher education for responding the new and changing world. The millenarians or digital natives are already used to living with technology, but the technological changes are so fast that if they do not prepare to face them, they will become obsolete soon. Hence the importance of continuous training and the need for institutions and companies to promote training courses for their employees. The Higher Education institutions have a key role on the promotion of knowledge and on the innovation, but this new scenario is an unexpected challenge that is difficult to face. Incorporating teaching of information and communications technology in universities within the curriculum, as a cross-training topic, is a difficult but necessary challenge for preparing students for success in labor market. In this paper, the importance of training in ICTs to get a job is raised. An empirical study with EUROSTAT data is carried out and is limited to young people between 16 and 24 years old. Structural Equation Modelling is the applied method. The results indicate that informal ICTs training favors employment and training in computer management.

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The conclusions point to the need to providing channels of self-training or informal personal training to fit the needs and temporal and spatial availability of each.

Keywords: ICTs education; youth employment; higher education; structural equation modelling

JEL Classification: I2, J2

1. Introduction

From the eighteenth century, the industrial revolution, radically transformed life at a planetary level. The three phases of the industrial revolution were continued with the forth revolution. The quick advances on Information and Communications Technologies (ICTs) drafts nowadays something similar with the extent of the internet, virtual environments, robotics, and artificial intelligence, but these new changes are probably are coming more, and more promptly, shaping a new industrial revolution of greater disruptive force than it could be initially expected. As World Economic Forum stated, in 2005, there were just 500 million devices connected to the Internet; today there are 8 billion, and it's estimated that by 2030 there will be 1 trillion (World Economic Forum - WEF, 2017). The innovation era is now, and it should start focusing on people. Despite the robotics importance on new production systems, the human capital is decisive within the workforce, and, in a fast-changing knowledge economy, 21st-century digital skills drive organizations' competitiveness and innovation capacity (van Laar, van Deursen, van Dijk, & de Haan, 2017). In this context, Universities have to face disruptive environments due to ICTs revolution, both as teaching and learning tool and as a new and crucial subject to teach for giving an integral formation to the students, who are mainly the so called "millennial generation" (the first generation borne immersed in new technologies). Davies, Fidler & Gorbis (2011) pointed out that success in the labor market is linked to the new media literacy and virtual collaboration, since they are two of the crucial skills that will be needed in the future workforce. In this field, younger individuals are the best performed for becoming Technology-Savvy Employees. The millennials are strongly skilled in these new communication and information technologies and they feel comfortable in virtual environments. This ICTs skills gives them a comparative advantage for social networking and their confidence on virtual collaborative atmospheres gives them the opportunity of integrating these productivity-enhancers into their work. In this sense, their particular innate conditions are in favor to their fast adaptation to technological changes and to quickly familiarize to self-learning digital environments.

The changing pedagogical models and the incorporation of Knowledge innovation is essential for universities survival. Milosevic et al. (2015) stated that Global network for Higher Education is not a fantasy and that leading scientists have begun to implement elements of research in teaching, because they know that universities and their colleges cannot exist separately from the social and technological environment, that is to say, from the current moment, so they must make progress in wider educational strategy of knowledge production. The main goal of universities is providing a solid and operative formation to their students, which lead them to achieve success in their personal and professional lives, as well as bring the results back to society in terms of general welfare. One main step for achieving this goal is to give to the university students' actual opportunities for getting a good job, since current trends reveal that it is not only the quantity of jobs but also the quality of jobs that matters, as few youth have access to productive employment opportunities that provide them with a decent wage, job security and good working conditions (International Labor Organization, ILO, 2017). Youth employment remains a global challenge and a top policy concern worldwide. The attendance to the university makes individuals more competitive in labor market, since university-educated youth are more likely to attain their desired job on their first try, but the changes introduced by the fourth revolution have to be assumed for a complete success at the university level. Growing up in the center of fast technological changes and globalization, today's youth are already expert on walking through unpredictable times and actually ready for assuming all kind of vicissitudes (Elder & Rosas, 2015). Since youth employment is a top policy concern, this paper deals with the importance of ICTs skills for getting a job.

After this introductory section, this paper analyzes the literature for focus the theoretical framework, attending the importance of ICTs both in education and in the labor market, and it stablish the main objectives of this work. The third section explain the material and methods and the results are shown in section four. The last section summarizes the main conclusions. The output of the computation with the results is shown in annex.

2. Technology, higher education and labor market

Disruptive changes to business models will have a profound impact on the employment landscape over the coming years (World Economic Forum, 2016). The technological changes high speed is out of doubt, the spread of the internet worldwide took only seven years. In addition, it cost decreases continuously. The Citi GPS Disruptive Innovations III report argued that stated that the cost of innovation extent, by means of the internet, continues to fall, as an example the cheaper smartphones, which will help bring four billion more people online. Over 96% of institutional clients who participated in Citi's survey on technology and work believe that automation will accelerate over the next five years vs. the previous five years (Citi, 2016). The world economy has greatly benefitted from technological advances. These advances have had important effects on the labor market. The impact of ICTs on labor market shows significant differences across countries and over time. Nevertheless, only some particular kind of jobs can be done by machines, then there are some skills which reinforce the employ maintenance (Peng, Anwar & Kang, 2017).

On the other hand, the society of knowledge is related to the sustainable development from a global perspective, since social sustainability is one of its pillars. Sustainable development is a general objective all over the world. This goal should be contextualized and properly balanced between all its areas. The triple bottom line (Brundtland, 1987) points to the three pillars for sustainability: environmental, economic and social and sustainability are all of them key pillars for achieving this goal. Moreover, the greater economic self-reliance of territories, supported by ICTs, can benefit both environmental sustainability and work opportunities (Robertson, 1995). The welfare of societies, employment and sustainability are wide and interrelated goals (Pociovalisteanu et al., 2015) and closely related to society and people way of life (Novo-Corti, González-Laxe & Pociovalisteanu, 2015). This interconnection is reinforced by globalization and Technologies of Communication and Information spreading, which should be accessible for everybody, and that is why the plenty access to the internet, both technical and economic, is an objective for policy makers (Alam, 2017; Leung & Zhang, 2017; Novo-Corti & Barreiro-Gen, 2015). Relating to the education and training, they will need to respond to the growing significance of the environment, of sustainable local economies, and of sustainable household management, as well as to the growing importance of ICTs (Robertson, 1995). Sustainable Higher Education environments are wider than just a high-quality educative contents (ie. generating inclusive environments, (Novo Corti, Pociovalisteanu & Iorgulescu, 2015)) and its scope goes beyond the time at the University, because it influences people performance and wellbeing all along their lives.

2.1. Education and skills in the 21st century

The education has ever been a key factor for achieving an employment. In the fourth industrial revolution era, the advances in technology are making a broader range of non-routine tasks automatable, with computers replacing mostly low-income low-skilled workers in the coming decades (Citi, 2016). The greater level of education of a country the highest level of per capita

income, because, a greater level of education results in higher labor productivity, and a greater level of education in the whole society tend to boost a higher rate of aggregate growth (Goldin & Katz, 2009). The key issue in the context of the fourth revolution, the one of knowledge and technology, to focus properly the adequate type of knowledge that colleges and universities should offer to respond the companies and societies demand on skilled knowledge. Most of these skills are under the umbrella of the so called digital competences, which are a set of different skills for achieving a good performance on digital society and which is a multi-faceted moving target, covering many areas and literacies and rapidly evolving as new technologies appear. Ferrari (2012) understand the Digital Competence as the convergence of multiple areas, related to the ability for understanding media, searching for information from a critical point of view and being able to communicate by means of various digital tools and applications (mobile, internet). Thon, for achieving these abilities is necessary to handle different disciplines and getting some competencies related to digital literacy. Facing this challenge is one important issue for Universities nowadays. Nevertheless, it seems to be very difficult to take this renewal from the traditional curricula perspective. Van Laar et al. (2017) have identified seven core skills for success in (technical, information management, communication, collaboration, creativity, critical thinking and problem solving) and five contextual skills (ethical awareness, cultural awareness, flexibility, self-direction and lifelong learning) (Table 1) and they point out that the dynamic changes in the types of jobs demanded by the knowledge society pose serious challenges to educational systems, as they are currently asked to prepare young people for jobs that may not yet exist.

Table 1. Digital skills

Framework with 21st-century digital skills	
Core skills	**Contextual skills**
Technical	Ethical awareness
Information management	Cultural awareness
Communication	Flexibility
Collaboration	Self-direction
Creativity	Lifelong learning
Critical thinking	
Problem solving	

Source: adaptation from (van Laar et al., 2017)

The European Centre for the Development of Vocational Training (CEDEFOP) assessed that in the European Union nearly half of the new job opportunities will require highly skilled workers (Citi, 2016). Improving education and training are key issues. They should be ready to prepare people for their personal as well as vocational life, in the context of globalized economies, international competitiveness, and ICTs era, where sustainable development should be achieved. This improvement of education should focus not only on vocational preparation, but also on personal preparation, not only for the information age, but also for sustainable development, and for constructive and useful participation in society, household and family" (Robertson, 1995). Long-life learning and training become core issues for getting a whole educative context. Lifelong learning is a continuous, voluntary, and self-motivated act to expand one's own knowledge (Kaur & Beri, 2016). The self-learning and personal implication on informal education come into the scene as an important player. Particularly, attending the fast changes in the knowledge society and the difficulty of assuming these changes by the traditional academic curricula. It has been proved (Chuang, 2017; Hsiao, Shu & Huang, 2017; Milosevic et al., 2015; Novo-Corti, Varela-Candamio & Ramil-DíAz, 2013), that there is a wide range of possibilities

for introducing the informal ICTs environments in formal education, in a simple way, more as a tool than as specific curricula content. Then, "learning by doing" gives a strong support for acquiring ICTs competencies as well as for improving students' performance in the typical curricular subjects. As a consequence, their integral technological knowledge and competencies will probably fit better with labor market exigencies. The innovative employability structure suggests that with the enhanced prevalence of ICT a wide array of individual factors impinges on employability (Green, 2017). Hasanefendic, Heitor & Horta (2016) argue that the actual policy discourse is increasing the pressure on higher education institutions for attending the claims of employers and their results indicates that best learning practices can have a potentially central role in minimizing the skill/labor market mismatch and that developing modern pedagogies could diminish the closure of the skill/labor market gap.

Required skills in the labor market are changing quickly, but computing systems are also changing at the same speed, so it would be possible understanding and anticipate these changes in labor markets in near-real time, and trying to re-shape education and training policies in a timelier manner to help to narrow the widening skills gap (World Economic Forum, 2016). Handling the resources for adapting the education to this changes is an important task for policymakers.

2.2. ICTs and employment

The extent of technological change is growing. The big data revolution and advances in machine learning algorithms indicates that the occupations that can be replaced by technology are also increasing, and this includes those tasks that were once thought just for humans, such as driving a car or interpreting handwriting (Citi, 2016). Rifkin (1995) stated that the technological advances lead to entering into a new phase in world history: one in which fewer and fewer workers will be needed to produce the goods and services for the global population, but it is only one part of the history. Technological advances have allowed the robotization of certain tasks, where people are replaced by machines. However, robots cannot replace people in skilled jobs. Rifkin words should be interpreted in its proper context, but the importance of the phenomenon should not be undervalued, since in the OECD the data shows on average 57% of jobs are susceptible to automation, this number rises to 69% in India and 77% in China (Citi, 2016).

Actually, some jobs may be diminished, but others will increase: who will manufacture the robots?. On the other hand, information and communication technologies (ICTs) have largely freed employees from the restrictions of a fixed, central work place, enabling mundane tasks to be distributed across remote locations, and these advancements make possible for corporations implementing flexible policies that allow employees to arrange their work and family concerns autonomously (Leung & Zhang, 2017). The core of this work is not addressed to the discussion about the advancements on ICTs and its effects and their assessment on the labor market, but it is important to be aware of the extent and importance of this issue. This work analyzes the relation on ICTs knowledge and the employment for young people in the European Union, since it is a key factor for understanding the disruption of higher education in the 21st century due to ICTs and its effects on students' employability and their possibilities of getting a decent work. Because, scaling up investments in decent jobs for youth is the best way for ensuring young people to achieve their aspirations and actively participate in society. It is also an investment in the well-being of societies and inclusive and sustainable development (Elder & Rosas, 2015). Moreover, there is a growing divergence in earnings between the most-educated and least-educated workers. The more skilled workers have the highest wages, despite that the supply of educated workers has also increased, which is a sign of the increase in the relative demand for

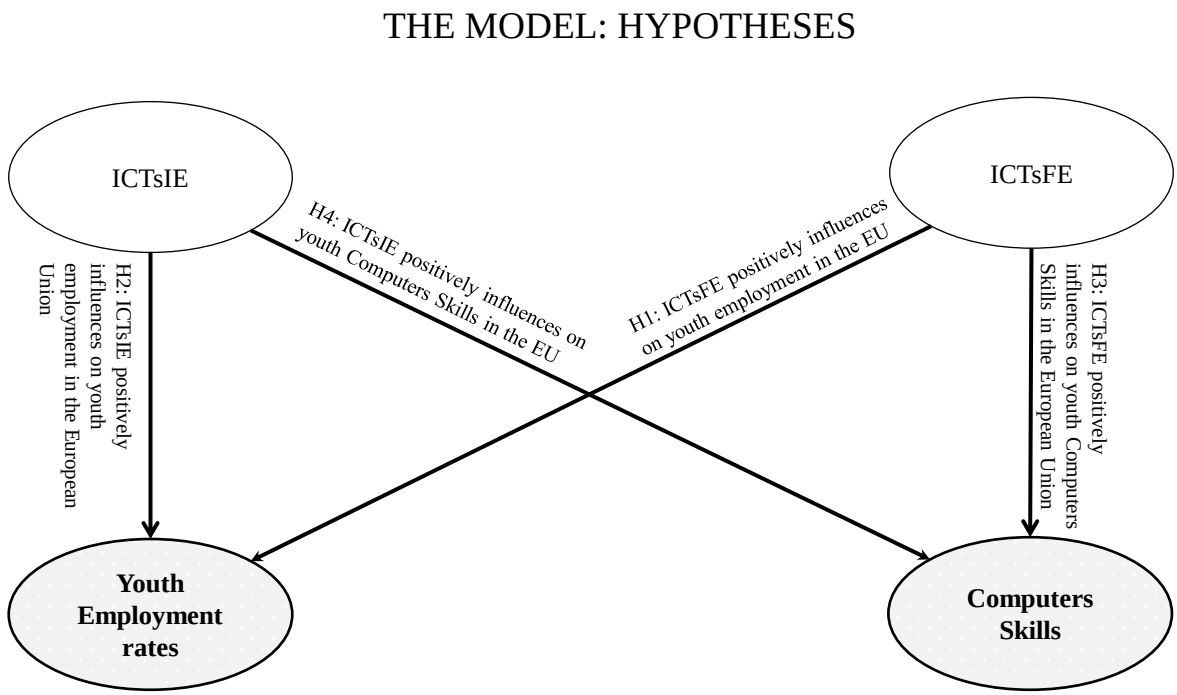
skilled labor. On the other hand, those with the least education, who typically already had the lowest wages, this change has increased overall income inequality (Brynjolfsson & McAfee, 2012).

Technological advancements together with the globalization are meaningfully transforming work. However, education and training systems, having remained mostly static and under-invested in for decades, are largely inadequate for these new labor markets" (WEF, 2017)[2]. Taking into account the current socioeconomic environment and the academic literature on this subject, it is verified that the training (formal and informal education) in ICTs is a fundamental aspect to find a job. Hence, the hypotheses to be contrasted in this work are those included in Table 2 and refer to the positive influence on the employment of such training. Four hypotheses are being tested: Two of them related to the influence of ICTs education on employment and other two related to the influence of ICTs education on Computers Skills. In addition, the formal and unformal education influence was considerate separately.

Table 2. Hypotheses

Hypotheses
H1: ICTsFE positively influences on youth employment in the European Union
H2: ICTsIE positively influences on youth employment in the European Union
H3: ICTsFE positively influences on youth Computers Skills in the European Union
H4: ICTsIE positively influences on youth Computers Skills in the European Union

Figure 1. The proposed model and the Hypotheses



[2] https://www.weforum.org/system-initiatives/education-gender-and-work

3. Material and Methods

Since the main goal of this paper is to analyze the influence of ICTs education on employment and Computers Skills in the European Unión for the youth, the data source was EUROSTAT, particularly the Youth data from the section Population and Social Conditions. Following EUROSTAT methodology, youth are considered those people between 15 and 24 years. All data are referred to that age range. Structural Equations Modelling is the most suitable method for assessing causal relations among unobservable variables. This method was proved as very effective for analyzing the ICTs use, impact and influence in education, from different perspectives (Lee, Chen & Chan, 2017; Milosevic et al., 2015; Varela-Candamio, Novo-Corti & Barreiro-Gen, 2014).

For testing causal relations a linear regression analysis is the proposed method. Nevertheless, since the involved variables are not directly measurable, the most suitable method for performing this analysis is the structural equation modelling, which lets the "construction" of those latent variables (or "constructs") by means of confirmatory factorial analysis, and, at the same time, is suitable for explaining causal relations between the latent variables. The IBM SPSS Statistics and AMOS 21 was the utilized software.

The Structural Equation Modelling has two main components: the measurement model and the structural model, for assessing the latent variables construction and the causal relations, respectively. The latent variables in the proposed model are the ICTs Formal Education (ICTsFE), the ICTs Unformal Education (ICTsIE), the Employment and the Computers skills. It is convenient to notice that the variable "Employment" could be taken as an observable variable, but to capture desegregate information related to education and employment, the variable was "constructed" taking account the different employment rates for the three educational levels. The latent variables for the model and their indicators are shown in Table 3. Moreover, information about the particular item of the database is also provided.

Table 3. Latent variables and indicators

Latent Variable	Item	Content
ICTsFE	High Education	Individuals with high education (levels 5-8) who have obtained IT skills through formalized educational institution (school, college, university, etc.)
	Medium Education	Individuals with medium education (levels 3-4) who have obtained IT skills through formalized educational institution (school, college, university, etc.)
	Low Education	Individuals with low education (levels 1-2) who have obtained IT skills through formalized educational institution (school, college, university, etc.)
	ICTsFE Males	Males who have obtained IT skills through formalized educational institution (school, college, university, etc.)
	ICTsFE Females	Females who have obtained IT skills through

		formalized educational institution (school, college, university, etc.)
ICTsIE	Self-Training	Individuals who have obtained IT skills through self-study (learning by doing)
	Adult Education	Individuals who have obtained IT skills through training courses and adult education centers
COMPUTERS SKILLS	For Job	Individuals who judge their current computer or internet skills to be sufficient if they were to look for a job or change job within a year
	For Computer Protection	Individuals who judge their current computer or internet skills to be sufficient to protect their personal data
	For Data Protection	Individuals who judge their current computer or internet skills to be sufficient to protect their private computer from virus or other computer infection
EMPLOYMENT	Primary Education	Employment of people 15 to 24 years for low education level (0-2)
	Secondary Education	Employment of people 15 to 24 years for medium education level (3-4)
	Tertiary Education	Employment of people 15 to 24 years for high education level (5-8)

4. Results

The Structural Equation Modelling, related to the measurement model, indicates that the estimated coefficients for the indicators, which are constructing the latent variables, are all statistically significant ($p < 0.05$), then we conclude that this significance of parameters indicates that the proposed relationship between analyzed variables has a substantial effect on the latent variable.

The equations for the measurement model (standardized estimates) are:

$$x_{11} = 0.28\,\xi_1 \quad \text{(Equation 1)}$$
$$x_{21} = 0.96\,\xi_1 \quad \text{(Equation 2)}$$
$$x_{31} = 0.61\xi_1 \quad \text{(Equation 3)}$$
$$x_{41} = 0.93\,\xi_1 \quad \text{(Equation 4)}$$
$$x_{51} = 0.99\xi_1 \quad \text{(Equation 5)}$$

Where:

$\xi_1 = ICTsFE$,
x_{11} = Individuals with high education (levels 5-8) who have obtained IT skills through formalized educational institution (school, college, university, etc.),
x_{21} = Individuals with medium education (levels 3-4) who have obtained IT skills through formalized educational institution (school, college, university, etc.),
x_{31} = Individuals with low education (levels 1-2) who have obtained IT skills through formalized educational institution (school, college, university, etc.)
x_{41} = Males who have obtained IT skills through formalized educational institution (school, college, university, etc.)
x_{51} = Females who have obtained IT skills through formalized educational institution (school, college, university, etc.)

$$x_{12} = 0.69\,\xi_2 \quad \text{(Equation 6)}$$
$$x_{22} = 0.66\,\xi_2 \quad \text{(Equation 7)}$$

Where:

$\xi_2 = ICTsIFE,$
x_{12} = Individuals who have obtained IT skills through self-study (learning by doing),
x_{22} = Individuals who have obtained IT skills through training courses and adult education centers

$$y_{11} = 0.81\,\eta_1 \quad \text{(Equation 8)}$$
$$y_{21} = 0.92\,\eta_1 \quad \text{(Equation 9)}$$
$$y_{31} = 0.74\,\eta_1 \quad \text{(Equation 10)}$$

Where:

$\eta_1 = Employment,$
y_{11} = Employment of people 15 to 24 years for low education level (0-2)
y_{21} =Employment of people 15 to 24 years for medium education level (3-4)
y_{31} =Employment of people 15 to 24 years for high education level (5-8)

$$y_{12} = 0.59\,\eta_2 \quad \text{(Equation 11)}$$
$$y_{22} = 0.90\,\eta_2 \quad \text{(Equation 12)}$$
$$y_{32} = 0.97\,\eta_2 \quad \text{(Equation 13)}$$

Where:

$\eta_1 = Employment,$
y_{11} = Employment of people 15 to 24 years for low education level (0-2)
y_{21} =Employment of people 15 to 24 years for medium education level (3-4)
y_{31} =Employment of people 15 to 24 years for high education level (5-8)

The assessment of the measurement model (see Table 4) is according to the literature scores for considering it adequate.

Table 4. Results for the measurement model

Latent Variable	**Observable Variable**	**Squared Multiple Correlations (λ^2)**	**CR**
ICTsFE	High Education	0.079	0.756
	Medium Education	0.922	
	Low Education	0.377	
	ICTsFE Males	0.868	
	ICTsFE Females	0.991	
ICTsIE	Self-Training	0.746	0.674
	Adult Education	0.432	
COMPUTERS SKILLS	For Job	0.586	0.900
	For Computer Protection	0.974	
	For Data Protection	0.900	
EMPLOYMENT	Primary Education	0.657	0.823
	Secondary Education	0.848	

	Tertiary Education	0.545

The reliability and internal consistency of the model, was tested by means of composite reliability and variance extracted values. Composite reliability (CR) should take scores ≥ 0.5 (Bagozzi & Yi, 1988) for confirming the internal consistency of constructs. Discriminant validity, for measuring the accuracy with which the analysis instrument represents the variables, the average variance extracted (AVE) values exceed 0.5 score (Hair, Tatham & Black, 1999) are considered adequate. Al values are into the scores, except for the AVE for ICTsFE, due to the differences between the medium and the primary and high levels.

As regards the overall adjustment, the most common measures for global fitness of the model are the comparative fit index CFI and the χ^2. The CFI scores goes from 0 to 1, accepted values indicated that it should be as close as possible to 1, but it is acceptable CFI > 0.9. The Chi-Squared/Degrees of freedom score is 1.476. CMin=88.546, DF=60 and P-value= 0.010. The reference values are $0 \leq \chi^2/df \leq 2$ for a good fitting (Carmines & McIver, 1981).

The structural model results are shown in Table 5. The main result is that the ICTsFE is not statistically significant for explaining Employment neither Computers Skills, whilst the ICTsIE is statistically significant for the explanation of both variables.

Table 5. Results for the structural model

Dependent Variable	Independent variable	Estimator	Standardized Estimator	S.E.	C.R.	P	R^2 (fitted)
Employment	ICTsIE	4.208	0.643	1.704	2.469	0.014	0.420
	ICTsFE	0.127	0.113	0.228	0.558	0.577	
Computer Skills	ICTsIE	5.285	0.848	1.711	3.089	0.002	0.751
	ICTsFE	0.238	0.222	0.234	1.015	0.310	

Attending the results for structural model, shown in Table 5 and in (Equation 14) and (Equation 15). The employment and Computer Skills are explained by means of ICTs education in a 42% and in a 75%, respectively. Taking account that the ICTsFE is not statistically significant for the explanation of none of these two latent variables (P-value 0.577 and 0.310, respectively), the relevant variable is the ICTsIE.

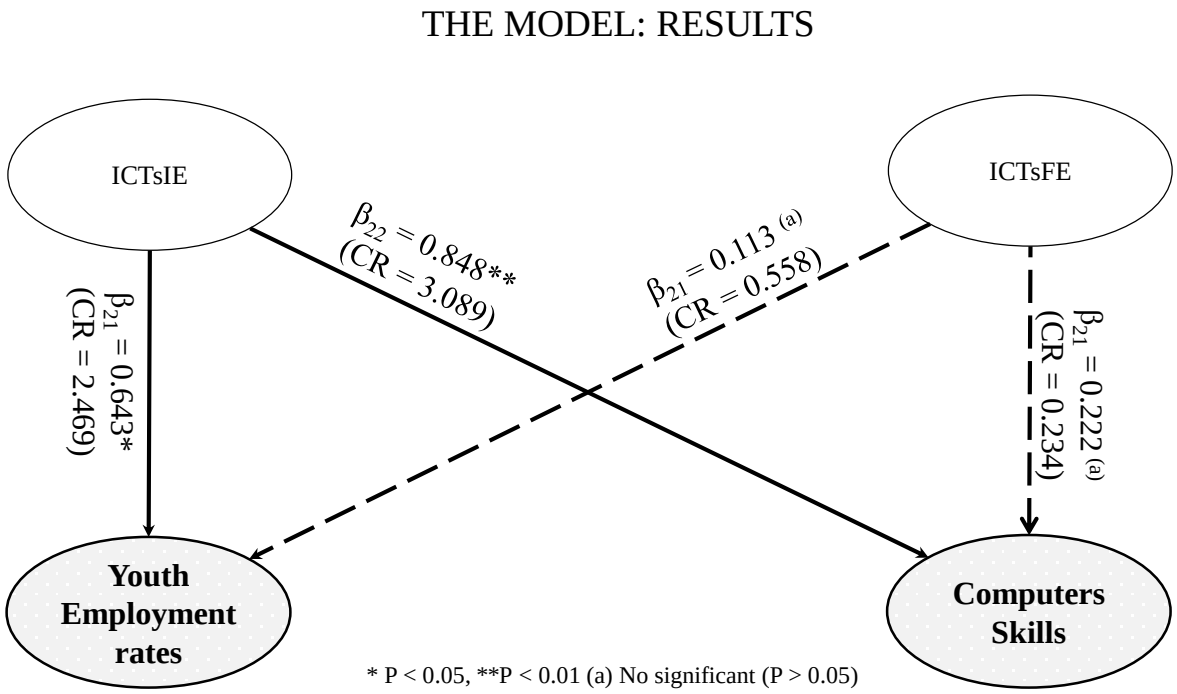
$$\eta_1 = 0.11\,\xi_1 + 0.64\,\xi_2 \quad \text{(Equation 14)}$$

$$\eta_2 = 0.22\,\xi_1 + 0.85\,\xi_2 \quad \text{(Equation 15)}$$

Table 6. Hypothesis testing

Hypotheses	Result
H1: ICTsFE positively influences on youth employment in the European Union	No supported
H2: ICTsIE positively influences on youth employment in the European Union	Supported
H3: ICTsFE positively influences on youth Computers Skills in the European Union	No supported
H4: ICTsIE positively influences on youth Computers Skills in the European Union	Supported

Figure 2. The proposed model and the Hypotheses



5. Conclusions

Current debates about the employment impact of disruptive change have sometimes been divided between those who foresee unlimited opportunities in newly emerging job categories and diagnoses that this scenario will improve workers' productivity and release them from repetitive work, and those that anticipate massive labor substitution and displacement of jobs (World Economic Forum, 2016). This debate is also in academia (Smith & Anderson, 2014). Nevertheless there is a common agreement on the urgency of getting skilled workers for facing this disruptive changes. The role of education becomes once again a focal point on the debate. Therefore, education on ICTs is a key factor for youth getting an employment, but also for helping societies to face successfully the forth industrial revolution. Anticipating the knowledge of some of this key skills needs will enhance this success for people and for societies. The results of this research point clearly to the importance of boosting informal education on ICTs. Therefore, it would be interesting incentivize and enhance collaborative designs on education, labor and knowledge society public policies to be ready for the challenge.

The policy implications from these conclusions point to the importance of promotion of self-learning environments as well as the long-life learning in ICTs for achieving those competences suitable for increasing youth employability.

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Annex: The results of the AMOS structural modelling