The techniques of the informatics workers:

Formal, Non formal and Informal education in the production of software[i]

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Abstract:

This paper intends, on one side, to describe in higher detail the relationship between informatics workers (those involved in the productions of software and related services) and the world of academic titles. But, on the other side, tries to shine a light on the origins of the working techniques effectively used by these workers. Some of them have an origin in interrupted bachelor careers; others have been acquired in specific courses, while most of them come from learning in their early socialization, learning by doing at the workplace and self-taught investigation during leisure time. We will try to specify the characteristics of the informal and formal paths thru which the IT workers acquire their subjective abilities. Despite this, the mere description of the empirical results of our fieldwork in Buenos Aires city would conclude in a failed interpretation of the phenomenon. Given this, one final objective of this paper is to locate our results in the bigger picture of the transformations which are taking place in capitalistic economies.

Introduction

In spite of what happens in other areas which involve high levels of innovation, software producers do no t necessarily have elevated academic credentials or, more precisely, do not give special value to those credentials when asked to describe where their working techniques where acquired. However this varies in relation to the type of production process in which the producer is involved. This paper intends, on one side, to describe in higher detail the relationship between informational workers and the world of academic titles. But, on the other side, tries to shine a light on the origins of the working techniques effectively used by these workers. Some of them have an origin in interrupted bachelor careers; others have been acquired in specific courses, while most of them come from learning in their early socialization, learning by doing at the workplace and self-taught investigation during leisure time. We will try to specify the characteristics of the informal and formal paths thru which the IT workers acquire their subjective abilities. Despite this, the mere description of our empirical results would conclude in a failed interpretation of the phenomenon. Given this, one final objective of this paper is to locate our results in the bigger picture of the transformations which are taking place in capitalistic economies.

This paper is organized as it follows. In the first section we suggest, based on a macro and quantitative approach, that the association between degrees and wealth is not as simple as proposed by many nowadays fashionable (speeches). In fact, recollecting data from the U.S. we show that the end of industrial capitalism takes place accompanied by a surprising alteration of tendency in the association between working force´s degrees and the amount of wealth produced by the economy. In a very synthetic way, we introduce some concepts to give a framework for the shown data: the appearance and growth of an Information Sector and Informational Work could be having a relevant role. Actually, one might be able to hypothesize that productive processes based on the elaboration and manipulation of digital information have contributed, partially, to alter the association between academic degrees and gross product. In a more specific manner, digital technologies, digital information (and the wider processes with which they interact) forces upon us to reconsider certain assumptions associated to usual notions of education and learning. This is what we do on the second segment of this paper. Based on the limits of formal education to account for abilities used in informational productive processes, we point out three types of education recognized by current literature: Formal (the one that takes place in the public and private education system), Not formal (specific training, courses and certifications) and Informal (non-institutional learning at the workplace or during off work time). Of course, software productive processes are the paradigmatic case of the listed tendencies. To these we dedicate most of this paper. In the third section we reveal how the relationship between software production and education has been treated in previous literature. Following we focus on the results of our qualitative work[ii]. Using concepts previously discussed, it´s organized around three types of questions. In the fourth segment we try to answer questions such as: Which is the relation between informatics producers and the academic world? How many of them obtain graduate and pos-graduate degrees? How much are those degrees required in the companies where their activities take place? How much do informatics workers give value, beyond credentials, to the learning acquired at university? The fifth segment is dedicated to the world of certifications and courses: which is the importance of these fast, non-academic but somewhat formal learnings? Which is the relative weight they have from the company's perspective? How do they contribute to the acquirement of techniques by workers? In the sixth segment we focus on the different kinds of informal learning. Among other questions, we try to answer the following: What kinds of leisure time learning are the

ones that allow the construction of software producer´s techniques? Which is the role of web based learning? Which is the relevance of workplace learning? Which attitudinal techniques are relevant? As a final point, we present our conclusions.

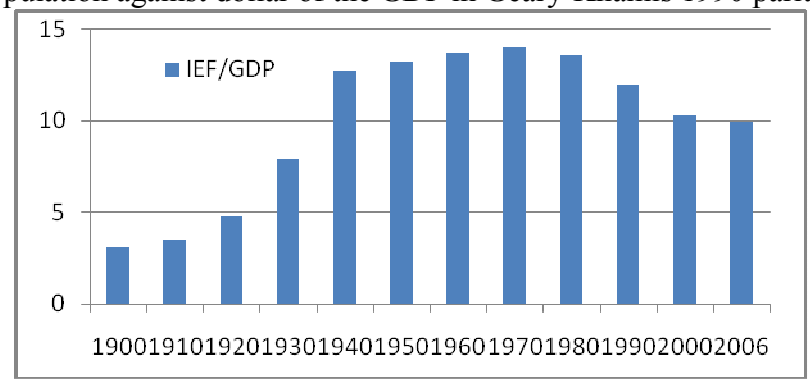
I

Academic qualification and wealth growth: Information sector and Informational work.

The arrival of informational capitalism (Castells, 2006) is accompanied by enfatic speeches regarding the relation between forma education and product growth. Reports of multilateral organisms, economist's papers and politics' speeches don`t miss a chance to heighten the importance of academic credentials. In the so called "Knowledge society" quantity and quality of the degrees shown by a country or a region are unavoidable data for both political choice-makers and the market: economic success seems to be closely related to them. However, if we analyze the relation between certificated knowledge active in the work-market and product growth maybe we´ll find some striking results. Here we synthesize a previous work that used data from the U.S. With this data we made a simple Formal Education Parameter (FEP) in economically active population.

Graphic 1

Formal educaction and gross domestic product per cápita
(EE.UU, 1900-2006; years of pondered formal educaction of economically active population against dollar of the GDP in Geary-Khamis 1990 parity)



Source: Zukerfeld, 2010.

This graphic shows how in the seventies – towards the end of the industrial period – there`s a significative change in the curve. While the "human capital" grows significantly more in the period between 1900 and 1950, and a little more between 1950

and 1970, since this decade the relation between index of formal education and gross product unit tends to be descendent. This can be explained with various factors, an argument that exceeds the space available in this paper. What cannot be denied is the declining level.

But although we do not pretend to explain this change, we do want to mention one of the factors that could be having a role in this transformation. Suppose in the last few decades a new economic sector was emerging and a new type of work. Imagine, also, this kind of activity has, in not always easy to measure ways, important positive influences on the product. Let`s assume, finally, that within this sector graduate`s knowledge was less important than it is in other sectors. It`s evident the growth of this sector and this type of work would partially explain the shift in the pendant. Well, this economic sector and this type of work do exist: they are the Information Sector and Informational Work.

Bibliography has analyzed informational productive processes based on two approaches: economic sector and labor. On both of them there is an extensive background. Here it`s sufficient to recover some of the concepts that have been discussed in earlier works. They`re based on a materialist perspective regarding the knowledge flow and on a critic of previous conceptual contributions (specially the inclusion of this modalities in the service sector). We call *primary informational goods* those made purely of digital information (music, movies, texts, data and certainly, software). Instead, *secondary informational goods* are those which process, transmit or store digital information (PC`s, smartphones and other digital technologies). We call *Information Sector* the one composed by the group of productive units whose primary output is primary informational goods. For example, some of these productive units are recording studios, consulting firms, call centers, micro companies devoted to graphic design, firms dedicated to industrial design and software companies (but also non mercantile productive units, as in nets which elaborate free software), among others. We use the *Information Work* category when referring to productive tasks of those workers who use as a primary work mean a secondary informational good, and obtain as a product a primary informational good. Graphic designers, ´data entry´, musicians, journalists, and, of course, programmers, are examples of these type of workers. Although informational work occurs mostly on the information sector, both notions must be distinguished. There is an increasing amount of informational work in other sectors of the economy (programmers in industrial companies) and, in a fewer quantity,

non informational types of work within the information sector (cleaning staff in a software company). Of course, we believe Informational Work and Information Sector have a physiognomy of their own, and we have developed a series of hypothesis regarding them in other articles (Zukerfeld, 2010a: Cap IX; 2010b; 2008). The only one of these that interests us in this paper is the one already mentioned: informational work seems to have, in a general approach, a particular relation to the education world. Naturally, we cannot discuss in this article this relation for every kind of informational work, but merely address it in the case of software producers. However, one must take into account that when advancing in this specific activity, we`ll be conceiving it as a piece in the informational work and information sector puzzle, and not as a curious island in the service or industry sector archipelago.

Given these considerations regarding sectorial and occupational transformations related to informational capitalism, it is necessary to introduce some concepts specifically associated to changes that have taken place in the educational area.

II

Formal, Non Formal and Informal Education

Here we are interested in the relation between informational work and techniques of workers. The configuration of informational capitalism and the related emergencies of the information sector and informational work haven't stopped provoking quakes in the educational system. In the interest of this work it`s useful to distinguish two types of transformations, simultaneous but carrying specific characters. The first of them is the one concerning bigger or smaller informationalization in the different education levels. Masification of informational goods provokes debate on how to incorporate and evaluate the contribution of digital technologies to the classroom space, but also regarding teachers formation and the reconfiguration of power division in the inside of educational institutions, among others (Jenkins et. al, 2006; Ito, 2009; Dussel y Quevedo, 2010).

All these debate surrounds the changes that emerge from informational goods as a *mean of*, as an *input* for learning. The other kind of transformation is a more specific one, and is related to the problems concerning the education of the specific segment of those to be informational workers. Here informational goods appear as an *end*, as an

output to be produced by those educated. On the first case, questions are related to the how to use digital technologies and digital information flows to learn any subject; in the latter, to the how developing the necessary abilities to produce them. Evidently, both matters are related. However, in this work we are especially interested in the second type of problem. Even more, we are interested in the debate on how a particular group of informational workers, that is, software producers, acquire their technical abilities.

In this sense, informatics education institutions reflect usually about their own situation. Basically because of the migration to the European Space for Higher Educaction[iii] (known as the Bologna Declaration), universities began to debate a shift towards the constructivist paradigm of teaching-learning. For example, a study by the Informatics Department of the Oviedo University, rethinks the techniques that should be given to the informatics engineers to adapt to market demands. So, we se how grows the necessity to pay attention not only to specific abilities, related to a study area, but also to what is called "generic or transversal competences" for all careers, and related to the integral formation of the worker, including attitudinal abilities and mostly practical ones: "So, it`s integration of different aspects: knowledge, skills and attitudes what forms competitiveness." (Aquilino et al; 2006:3). Some techniques called soft skills, interpersonal, transversal, conceptual or social according to different studies, aim to emphasize the necessity that non technological competences become a part of higher education. For example currently collaborative or cooperative ways of learning are being discussed (Labra et al; 2006) or knowledge based on problems (Barg et al, 2000; Catalán et al, 2005; Hernández et al, 2006) as renewing methods for de informatics sector. These turning on formal education make evident a highly known subject in the world of educational sciences: education is not equal or reducible to the effects of a forma educational system, in any of it´s levels (Coombs y Ahmed, 1975; Trilla, 1993, Burbules y Callister. 2008; Dussel y Quevedo, 2010). In such sense, we witness the emergency of notions as "permanent education". Indeed, also in the economics field some useful concepts have been spread to account for extra-academical learning (know how, tacit knowledge, learning by doing, learning by interacting, etc. Vid. Foray, 2004). All these contributions oblige to precise the different sources for learning that´ll be considered in this paper.

When referring to abilities, skills or individual competences of informatics workers we`ll use the term techniques (other authors talk about competences, skills, etc.): we define them as procedural subjective knowledge applied in an implicit manner

(for discussion on these definition, Vid Zukerfeld 2007: 36; 2010, Volume I, Chapter V)) So the technique notion here used refers, not just to abilities related to technology use, but also to every form of internal individual knowledge. Consequently and following specific literature, we can define three kinds of vehicles for the acquisition of techniques by informatics workers. These are *Formal Education, Non Formal Education* and *Informal Education.*

First of all, naturally, *Formal Education*. Here we`ll use this term to refer to the abilities acquired through passage on university or tertiary grounds, either bachelor or following academic degrees. Specifically, for knowledge reckoned with diploma we reserve the word titled, which we`ve already used. Formal Education includes, like this, "the highly institutionalized education system, chronologically graduated and hierarchically structured, which extends from the first years of primary school to the last years of University "(Coombs y Ahmed, 1975: 27) and also, let`s add, post bachelor education.

Following, we understand as Non Formal Educaction "every organized activity, systematic, educational, done on the outsides of the official system, to facilitate certain types of learning to specific sub-groups of the population, either adults or children", (Coombs y Ahmed, 1975: 27). In this sense, objectives tend to be more specific, sectorial and delimited tan those of formal education (Trilla, 1992). In the specific case of software producers, we are interested in three specific forms of non formal education: *courses, capacitations,* and *certifications*. All of them refer to specific seminars organized institutionally, and usually, with a strictly private character. The difference is that here we use the term *course* when referring to those forms of instruction which do not offer an especially valuable enabling credential. Courses only give the worker the knowledge acquired within them. On the other hand, *Certifications*[iv] provide a vouching document required by the work market. Of course, most certifications include previous courses, but the key here is that in this case an important part of the outlay this seminars represent occur because of the guarantee that the obtained credential represents. Finally, we call *Capacitation* (*or training courses*) when speaking of a particular type of courses: those that are organized by the productive unit in which the worker is active.

The proposed distinction between formal and non formal education is related to certain criteria of duration, institutionality and structure. However, we believe is necessary to add a fourth criterion, legal-administrative, which is the provision of academic titles and the reckoning of them by the Estate (Vázquez, 1998). Besides, non

formal education also has the minor characteristic of being almost exclusively private. If the formal system tends to, by its own nature, to standardization and uniformity, the non formal one tends to take into consideration immediate necessities to select the most applicable contents. It possesses, compared to the first, a much larger capacity for adaptation to constant shifting in used languages and technologies. Consequently, it seems to be highly functional to solve market demands.

On third place, we have the heterogeneous category of Informal Education. It`s defined as "…a process which lasts life long and in which people acquire and accumulate knowledge, abilities, attitudes and ways of knowing through daily experience and relation to the environment" (Coombs y Ahmed, 1975: 27). The term refers to all forms of technique incorporation which do not depend on an institutional counterpart. The most important difference regarding formal and non formal education lays, consequently, in the absence of organization and systematization (Touriñán, 1983). It includes everything from strictly autodidactic mechanisms and search of information through internet forums, and the teaching which emerges from labor experience – sometimes called learning by doing -, to knowledge circling in pair circles, etc.

Naturally, the three concepts presented will be the ones we`ll take on when analyzing the origin of techniques by informational workers. In this way, the characters of, and the differences between, these three types of education will be of use to delimitate and frame relevant knowledge, and also the significative ways of teaching-learning related to the world of software production.

III

Different kinds of education in software productive processes: some background

In this section we will review some background around formal, non formal and informal education in software productive processes in Latin America and Argentina. The data available is, certainly, fragmentary and far from strictly comparable. However, we´ll review them briefly.

In a general aspect, most recent studies, and the ones with higher empirical basis, in the Latin-American field, have mostly quantitative and economical approach. In part because of the need to include just what can be measured, this valuable contributions usually focus excessively on formal education. Like this, the "quality in the offer on human resources" (Tigre et al; 2009: 8) or the "level of formation" " (López

y Ramos; 2007: 37) are investigated merely in terms of formal education, by taking as indicators of formation assistance level (in technique schools, and bachelor and post-bachelor careers), the accomplishment of a degree or previous desertion.

In Argentina, the tendence is similar, at least in pioneering studies. Following along these lines, "academic offer" and "graduate`s offer" are seen as indicators of the sector`s human resources quality, always within the limits of what we here call formal education. And although lack of "practice" or a "too academic orientation" of the graduates are mentioned (Chudnovsky et al; 2001: 80), this is explained mostly because of the errors of the formal educational system, without reference to the knowledge acquired within other education choices.

All in all, recently other studies have appeared that take into account in an explicit manner factors which exceed formal education. One work done by investigators of General Sarmiento National University, based on a survey made in collaboration with the SADIO[v], proposes four profiles in relation to techniques (referred to as "competences") of informatics workers (Borello, Erbes, Robert y Yoguel, 2004). This profiles are confectioned based on five variables i) tools that they can handle ii) activities they take on iii) The complexity of development projects the are part of iv) the degree of use regarding the nets in which they participate V) level of formal education in the informatics field. Because of this, we cannot translate directly this research in terms of Formal, Non Formal, and Informal Education. However, one might offer an approximation, given that GSNU researchers take more or less into account these paths for the acquirement of knowledge.

When observing all groups and taking focus on formal education, one result seems clear: *it isn`t verified that possession of degree is related to possession of high technical levels (or competence levels) which express themselves in the doing of complex activities*. University`s formation does not constitute a crucial factor – although it isn`t irrelevant – in the development of technical capacities among workers. Within the first two groups, many of the workers who have high qualification levels do simple tasks (with or without possession of advance technique). Within the fourth group, in a complementary manner, there is an important amount of workers who, without possessing differential levels in formal education and even with low competence levels, take on complex tasks. This conclusion, which verifies on the hypothesis proposed by the mentioned study, confirms the background of previous works referred by the authors (Boscherini et al, 2003; López-Bassols, 2002; Micheli, 2004). These objective

verification matches the representation of the workers: "…72% of the interviewed subjects do not consider they have obtained the largest part of their capacitating within formal studies, standing first formation within current or previous workplace (44%) and, in a lesser quantity, autodidactic formation (25%)"(Borello et al, 2004: 23).

As part of the same research, and consequently, with a similar theoretical framework, Valeria Robert investigates Free Software (FS) production. In a specific article she reflects on techniques within these particular informatics group (Robert, 2006). Without using explicitly the words Informal Education, the author gives account for its importance when expressing that FS, as an "epistemic community", allows collaborator to generate and widen creation and knowledge processes. Also, knowledge which flows within programmers nets are perceived as open but not as ones of unrestricted access: they have entry barriers given by the subject`s *capacity of absorption* and by level of connectivity or network use. There *learning by doing* is combined in a way which includes experience, personal trajectory and *learning by interacting.* This work as much as the previous one are framed within the tendencies of neoschumpeterian and evolutionary economy. Instead, the next one emerges from labor sociology.

So in third place, we must mention a recent article by Montes Cató (2010) based on Marxist contributions. The acquisition of techniques is characterized there in relation to a theoretical frame which is based on the mechanisms of worker`s exploitation. Like this, the necessity of "constant formation" (what we call non formal and informal education) is perceived as a battlefield, and not as a neutral element. Besides certification and learning in the workplace, the accent is mostly on the demand for "multiqualifiying polyvalence", one which includes attitudinal abilities (and also flexibility for permanent changing). This work, however, does not take into account the origin and distinction of these diverse qualifications and does not have an empirical basis as the one in other articles.

In short, we can observe that, even in Argentina, literature has identified the different types of formal, non formal and informal education as problems to be discussed. All in all, we can add now that one of the limitations that this works have is that they do not distinguish the particularities of the different software productive processes. One would expect, that the relation between techniques and formal, non formal and informal education might vary between big companies and micro companies; and also between state production and FS production, or in the case of

academic research and in house production. Following then, we explore our empirical data taking into account, when possible, these distinctions. It`s also important to add that we will be using a double record. On one side, the one of more or less objective data: E.g.: which studies a worker possesses, which languages he uses in his tasks. On the other side lie subjective representations: the level of importance given by the worker to what has been learned through one education type or the other.

IV.
Formal Education

Interviews we`ve done present heterogeneous situations regarding the world of formal education. However, there are some common characters. Every one of them has achieved a high school degree, and they have all started some kind of tertiary or college education. In some cases, this formal education is not related with informatics. Naturally, in order to discuss the relevance given by informatics workers to Formal Education, these cases must be excluded. Now, among those who did start careers related to informatics (although they are diverse[vi]) we find three types of situations: those who have finished their studies (nine of the interviewed), those who are actively taking courses (two) and those who have abandoned or take courses at a really low rate (seven). The most relevant question, when discussing the weight given to formal education, is the one which refers to *where have our interviewed workers acquired the knowledge they reckon as more useful to their professional performance*. We are only interested here in the polarized distinction between those who have mentioned college and those who have mentioned other sources (leaving formal education on the background or giving it a marginal importance).

It is no surprise to find that, within the group of those who´ve abandoned their college career or those who take their courses at a really low rate, all the interviewed correspond in excluding formal education as a primary source of useful knowledge, and in prioritize other sources for learning.

> - On my own, basically. Making little programs and stuff por myself, not work related. (BA, employee in multinational company)
> - In life, neither in college neither in work. The pro-activity, and being eager to learn wasn´t tought to me by anyone, or maybe my family thought me that, or my environment. Knowing how to work is anecdotic. (GCF, employee in the state)

- In front of the computer, and my parents teached me English when little, because that is fundamental, almost more than school. They made me learn English, it was formal. The informatics part was trial and error, in front of the computer. (GRT, partner in small company).
- With me, there was many people with lots of patience…One with his knowledge does that which makes you more comfortable. For example, I wouldn´t mess with Kernell…In order to work with Kernell, for instance, must one have a college degree? No. I, for example, I am pretty anti-academic. There´s a character one has, it´s experience. For instance, for Kernell you need to be square, sharp. Or for the installer, one has to test it hundreds of times. For that you must have a really particular personality. (TM, Free software developer)

In fact, within this group the situation of having abandoned the career, or doing so in a lower pace than the normal one, suggests that academic formation is not perceived as a priority. Which are the causes for abandonment? Those interviewed mention some in an explicit way, while suggesting others.

- It bored me. Besides, I was in a situation where I had to work many hours and informatics careers, specially during the first years, have lots of mathematics, lots of physics, aaarf. (TM, Free software developer)
- Because I didn´t like either one of them. In Systems, I thought it was complex and it wasn`t what I was searching for. I couldn't decide which career to follow. So, since I liked computers and when I was fifteen I already installed Windows, I though of Systems. I entered, did not see any programming stuff for a whole year, and I didn´t think it was like that. I got bored, nothing got me interested. I never put too much effort into it either. That´s when I started working, and told myself, lets find somewhere else. In Administration I did well, started in Spain, no effort, I just surfed it. But here the one hour trip didn´t motivate me at all. (GRT, partner in small company)
- I signed up but the system ingeneering faculty from the UTN [National Technological University] is in Lugano, I don´t have the time to do it. Time didn´t allow me a full time work. So I told myself no, I can´t do this, not even for three weeks, I´ll give up along the road. So I said, ok, I can´t. In that faculty I can´t. (MA, DBA in multinational company)

In this sense, from the interviews (which exceed previous quotes) emerge two types of elements:

i) Knowledge offered by universities aren´t necessary for work market insertion in positions that interviewed workers find as satisfactory. This is the most repeated cause by the interviewed of this and other groups and conduct to the discussion of the reasons for this gap. We won´t be entering into this debate here, but we can point out two things that were present in the interviews. The first one is the one related to the slow pace of renovation within the formal education's curriculum, in opposition to the hectic renovation in programs, languages and technologies perceived by the students.

The second one is the existence of a persistent demand for workers without bachelor degrees. Even if knowledge provided by college was perceived as valuable, potential students don't find incentives for resigning immediate work offers.

ii) Regarding some of the subjects related to mathematics, the interviewee's lack of interest , mentioned in many cases, and the difficulties to approve – which are silenced, or are referred to in a elliptic way – are a decisive component of desertion. To many of those programming professionally, to concentrate in mathematical abstractions and move away from concrete programming, appears as a displeasing deferral. This must be interpreted framing it within a productive activity which, contrary to what occurs in other works, appears as extremely rewarding (exceeding economical reasons) for almost all of the interviewed. Of course, the animosity of most informatics towards some subjects in college careers is related to the low level of mathematics dragged since high school formation. But this is also relative: we find some cases of chronic students or deserters between those who have had an excellent high school formation.

In second place, we have the other two sub groups: those actively taking courses and those who have already obtained their diplomas. Here one might expect, in contrast with the previous group, a strong valorization of formal education. We are talking of those who have invested, or are investing, different resources in order to obtain academic knowledge or the degree that comes along with them. However, obtained answers go in the opposite direction. Of the nine interviewed who own a degree in the area, six point out areas which are not within formal education as the most relevant for acquisition of techniques.

> - Within informatics there are many people who maybe did not study a thing and performs better than you, because they are smarter, or something. – Do you agree on that? – I think it´s more important, in my case, what I was carrying since I was eight than the college career. If I hadn´t done my career, I could still do what I do now. (DBJL, partner in a small company)
> - Work experience, intuition, the web…Google (laughs) (RA, partner/manager in a medium company)
> - In front of the machine (SC, micro company programmer)
> - Programming (CA, investigator in big company)
> - When working, experience (GH, multinational company manager)
> - In the job (ZA, manager in a big company, in house production)

It´s also really interesting that two of the three interviewed who do give university a decisive weight in formation are linked to academic activity: one is a

doctoral grant student (although he passed through the private sector), and the other one already has a doctor degree, and is a professor in Buenos Aires University.

Beyond the aspect related to representation, which we have analyzed, the relevance of formal education can be studied through some objective parameters, which do not necessarily coincide with the first. One the these parameters is the one related to the relevance given to formal education by those who take parte in the decision making regarding the hiring of informatics workers. The perspective of those who demand and those who offer seems to be the same, at least between our interviewed. Managers value potential, attitude, compromise with the company and other aspects, before academic credentials.

> - Regarding those hired, do you worry about qualifications or how do they get to be in the company? – Not that much concern in qualifications, we do search for references. To the technical staff we fundamentally make some kind of exam, to see some of the aptitudes. But fundamentally what we are looking for is more the potential of the individual rather than the specific knowledge he or she has at the time. If, for instance, he doesn´t know a language, but we see he´s got the capacity or formation to acquire it, it goes. (PH, manager in a large company)
> - To me, it's more important attitudinal characters than theoretical knowledge. (ZA, manager in a large company, in house production)
> - (Regarding the possibility for an employee to be promoted)…the academic thing is not, in any way, a restriction. Attitudinal and professional attitudes, and years of work on the position (GH, manager in a multinational company)

On the other side of the counter, when asked what was asked of them when entering the productive process, workers emphasize different aspects, but possession of a degree just has a marginal role[vii].

> - Well, you know how I told you they work with .net. During my previous job I didn´t see any of that. What I knew I knew on my own. During the job interview they asked me if I knew, they made me a technical evaluation that I passed on the count of what I had learned on my own, not during work. – Did they ask you what techniques you had and asked you for a certification of this or did they just make the evaluation there?- No, no. They make technical questions, questions which you can´t answer if you are not familiarized with the technology. (BA, programmer in a multinational company)
> - Language and technical knowledge. In a serious of interviews. First, the one by human resources, afterwards some kind of technical interview, afterwards another one related to human resources but in English, afterwards a technical interview in English. Four interviews. Even though they were made during two days. Two each day. (ML, programmer in a multinational company)
> - Generally you have an interview with someone who doesn´t know a thing. Afterwards you have an interview with someone who knows a little more. What really works is to know how to solve problems. (CA, researcher in a large company)

- When I was hired for this job, I didn´t go through a process…I had a task that had to be done and they saw that I was right for it… but there weren´t questions regarding whether I knew or not anything in particular. (SF, programmer in the State)
- In Debian, it´s important that you have to surpass a time bar of contribution, of technical ability, of being known in the community, of Debian philosophy, all that replaces formal certification. But there is a community certification, it´s a particular mechanism. (TM, Free software developer).

However, one must introduce some considerations that bring new shades to this relative depreciation of degrees. They appear when taking into account the differential characters on productive processes in which degree possessors and non possessors are involved. Although, of course, one must insist we do not have a representative sample, common patterns on our fieldwork makes us deliver some early hypothesis. First, it would seem that possessors of degrees tend to win more than non possessors, although this covers up a substantial vary in the last group. In fact, the highest income of the interviewed workers comes from a micro company conducted by an entrepreneur who does not possess college studies. In other words, *it would seem that degree possessors have for sure a higher minimum wage than non possessors, but some of the last ones have a higher maximum.* This, of course, corresponds with the mythical image of Facebook, Google or Microsoft founders, who left college to dedicate the whole of their time to taking radical innovations to the market. Quantitative research should test this hypothesis. Secondly, *it would seem that non possessors dominate clearly on the micro and small software producing companies segment, while those who do possess a degree dominate in high level design positions, and, in a more diffuse way, in the different roles distributed in large and medium productive units*[viii]. In this sense, we could compare qualifications asked for each position in a medium company which develops systems and specific apps, and a large local company which markets a packaged product.

Table 1

Qualifications required for differente roles in two companies

Role	Qualification and techniques required	
	RA- Local médium company	OJ-Large local company
a) *Requirements analysis* and	"I´m interested in them having social abilities. Relations."	"More experience within the company is requested, or people who enters and comes from other jobs with large responsibilities"

high level design		
b) Low level design.	"It has to be more of a technical person; with more technical knowledge."	"Informatics engineer, it wasn´t mandatory. Student or graduate."
c) Codification	"I´m interested in him/her being passionate for technology. I´m really interested in the human profile, regarding the work group, that he/she likes group work."	Same as b)
d) Testing	"The most important thing is for him/her to be a meticulous and ordered person. And a responsible one. "	Same as b)
e) Tech support	No answer	No answer
f) Others (*describe*)	"For presale…selling abilities and systems knowledge."	For research, "They looked for computer scientists, mathematicians, coming from exact sciences. All graduates."

In short, when explaining the origin of informatics worker´s techniques, formal education tends to be poorly ranked by those who have deserted from it, but it´s neither valued by those who have obtained degrees. The same occurs when asking about what kind of knowledge had been required to enter the productive processes which concern us: applicants as much as employers relegate formal education, and specially, possession of a degree. However, this might vary according to the type of productive process. In some cases, larger companies demand, especially for specific positions, certain formal qualifications. Of course, these are the most attractive in hierarchy terms and, consistently, the better paid ones. In a more general perspective, possessors of degrees obtain, in average, better wages than those who haven´t achieved a degree. This summary has some contradictions that should be addressed to in future studies. They can be resumed in this way: *if bachelors do not possess more relevant techniques than those who haven't achieve a degree, how is it possible that their wages are higher and that they occupy more relevant roles?* In this sense, if bachelors win more, *how is it possible interviewed workers don´t value obtainment of degrees?* At least two

preliminary hypothesis can be introduced as a final note on this section. The first one is related to the second question. An insufficient opinion, in our view, would be to believe that there is a problem related to lack of information: informatics workers don´t know that they´ll make better wages in the future if they follow a college career. *On the contrary, it would seem that for most informatics workers, who love they´re jobs, economic incentives are not decisive*. The borderline case, the weberian ideal type in this notion, is the one which emerges when dealing with Free Software productive processes. Programmers who deal with high complexity levels develop their tasks without any economical reward – at least in most cases -. But besides this extreme case, something of this consummatory spirit we see in the activity seems to be present in almost all of the interviewed who take on development and programming tasks, although this is much less present in those who are in managing positions – who do seem to be more sensitive to economic incentives-.

But returning to the same question, how to explain that university does not provide indispensable techniques but those who spend more years in it have more chances to end up in leading roles and productive processes? One of the factors to keep in mind is the fact that transit through superior education gives other forms of knowledge which are not related to techniques, but are extremely relevant for a favorable insertion in the work market. Maybe the primary of all these forms is the insertion in a contact net, (Bourdieu´s social capital, Lundvall´s know how, or what in other works we´ve called CSI *Reconocimiento*, vid. Zukerfeld 2010: Volume I, Chapter VI) [ix]. The possibility of obtaining contacts for future work insertion, of knowing other programmers who´ll usually provide informal learning, or whom, eventually, will be partners in later ventures seem to be relevant elements. It´d be good that non technical resources offered by informatics formal education would be part of the future research agenda in this area.

V

Non-formal education: Courses, Training courses and Certifications

As we pointed out in section II, we will focus on some specific types of non-formal education: courses, training courses and certifications. They are, predominantly, commercial fields of education, whose main characteristic is its highly particularized focus about specific software, at the expense of a comprehensive and lengthy curriculum. Courses, training courses and certifications are typically dimensioned to

learning and practical mastery of a particular programming language, the use of precise tools, or even organizational skills and management of production processes. We should remember that certifications are often a particular type of courses that offer a legitimating credential that is valued by relevant stakeholders in the field. Meanwhile, training courses are another particular type of courses that take place within the productive unit. The term "courses", period, designates in this work those who were not included in the previous categories.

The starting point is given here by a general observation on the three types of non-formal education that radicalizes a suggestion made about formal education. Other variables notwithstanding (the type of formal education, the type of productive process and the role in such process),when our interviewees were asked about the source of the knowledge that they find most useful in their work, none of them pointed out the courses, training courses or certifications[x]. Only two of our 24 interviewees mentioned some of these methods to answer this question. Both are managers, several generations older than most of our interviewees, and their references were far from valuing non-formal education. So says one of them:

> -There are kids that do a course and ask for a fortune. But they are developers who can't do anything else, they can't make a design analysis. For that, the university is useful for a global view. (ZA, in house manager in a large company).

However this manifestation on the representations of the interviewees, it would be wrong to conclude that they have not received formal education, that they do not appreciate it at all, or that it is not objectively relevant to the labor market. Each type of non-formal education (certificates, courses, training courses) has its peculiarities.

Regarding the certificates, at the time of the questionnaire and based on the literature surveyed, we assumed that they would be particularly relevant for supplying endorsements that would bridge the gap left by formal education. However, this was not verified for the majority of production processes. In the first place, of the 24 interviewees, only seven have some type of certification, and none has more than two of them. This stands in contrast with the courses: some of our respondents made more than ten of them. It should be noted that all respondents agree that the prices of the certificates are high, if not prohibitive[xi].

There is, however, an important subdivision within those who do have some sort of certification. On the one hand, those who obtained them within the framework of the

productive unit where they work and paid by it; on the other hand, those that got them previously (or parallel) to their admission to the workforce, and paid the certification for themselves. While the former act on large enterprises, the latter are part of small production processes or work primarily in another activity at the time of doing them. The former have easy access to certificates and can take them, either because they positively evaluate the relationship between time they will spend and the results they will obtain, or because, just as with training courses, a diffuse coercion is exerted upon employees to take advantage of them.

> -The company pays. They are offered by the team leaders. They get together, the list is set, and with the managers they decide who goes and who does not (ML, Programmer in a multinational company)
> -The company gave them. The courses were expensive. (RA, Managing partner in a medium-sized enterprise).
> -The company. Any training that you want to do, they refund it. They also pay for college (BA, Developer in a multinational corporation)
> -It was given by training consultants for the company. They are not open to the public (GFC, government programmer).
> - They are so-so. You are invited and you can refuse for work reasons. But it is assumed that you need to do them in the long run (MA, DBA in a multinational corporation).

Conversely, it would seem that those who paid for these expensive endorsements elected them imagining them to be passports to the labor market, regardless of the techniques they were hoping to acquire. For instance, MA decided to start a DBA course:

> -You begin to see what's more popular. SAP and Oracle were often mentioned. And I went that way. (MA, multinational corporation DBA)

Then, still without having completed the course, the respondent entered into a multinational corporation and finished it later as an employee. However, having obtained a job, she did not deem it necessary to take the certification examination. Consequently, this certification seems to have ended up, paradoxically, extremely relevant as a course, and not as a certification. Although the respondent thought otherwise, the acquisition of skills was significant enough to allow her to enter the labor market.

It should be noted here that when we point to the size of the production processes as a dividing barrier regarding the certifications, we are referring specifically to market production processes. Among our interviewees involved in production processes within either the government or the NGOs, none of them had any

certifications. In fact, certifications are logically associated with the business world: it seems that larger productive processes, and particularly transnational ones, require endorsements that signal the skills of their hosts of IT specialists.

To sum up, our hypotheses about the certifications are: i) They seem to be strictly linked to either large firms or multinationals, ii) Although respondents who took them as a means of entering production processes that they were excluded from highlighted their function as endorsements, it is not clear that the credential is particularly relevant *for entering firms*. Contrarily, in some cases the techniques that these expensive courses provide contribute to this end. iii) However, once inside these companies, certifications seem to be useful from the perspective of firms not only to transmit knowledge (as courses or training courses) but also for distinguishing their employees.

The link between formal education and large size of the production processes is maintained when we move towards courses and training courses (although now including government production processes as well). In practice, respondents who took more courses often took them as training courses. Thus large production units have access to varied and relatively constant training course. On the contrary, training courses in small production units do not exist; on medium-sized ones they exist sometimes, but when they do not, this is seen as a shortcoming by the respondents.

On the other hand, observing the phenomenon from the worker's perspective, our interviewees have a greater number of courses and training courses than certifications. Of the twenty-four respondents, fourteen have made a course (almost all have made more than four and some, as noted, have made more than ten).

The interviewees clearly distinguish between two types of training courses: on the one hand, training courses about new work methods, technologies or particular languages; on the other hand, training courses regarding attitudinal techniques: personnel management, customer service, negotiation, teamwork, etc. The following quotations make this distinction explicit, and add some features of these training courses:

> -They're optional, there are technical courses and courses more like…management, or more social, that would be negotiation (OJ, programmer, large local company)
> - Endless. There are two types of courses: internal and external training. Internal is given by someone from AAA (government agency) for the AAA's own people, on admission. It's mandatory. Usually you get sent to courses, for instance we're now making one because we were all from .Net and they wanted to send us to Java.

> Those who choose not to go for any reason don't go, but most do, specially because it's a full day, eight hours in a course away from your boss (GFC, government programmer)
> -Rarely. Sometimes there're three in the same month and then you don't get any in the whole year. –What are they? –Technical and non-technical. They do what's called workshop, communication, teamwork, negotiation, customer service (MA, multinational company DBA).
> -There are curricula where people sign up to. They're not geared towards software, but rather they're attitudinal, of teamwork, written composition. They're covered by the contract. It's a company benefit (GH, multinational manager).

One last fact about the relationship between different forms of informational education and large production processes concerns the protection of the investment in human resources that the latter perform. Repeatedly, in the interviews appeared the problem of the appropriability of the investment made in non-formal education. Firms (and in some cases the government) fear being used as a source of paid technical learning of workers who are then hired by other companies.

> -The external training courses are paid by the AAA (national government agency) but you have to spend two years in AAA, they make you sign a contract. This is very common in software companies, forcing you to say, because many people did the training and left. What happened was, they paid a ten thousand dollars certification, and next door offered a higher salary, and you lost the 'resource'. BBB enterprise (multinational company) has partnered with CCC (multinational company), unofficially, for six months they don't hire you in CCC if you work in X. It is in order to avoid competing for resources. –Are they covered under the employment contract? –There are endless types of contracts, but no. In no way will they commit to pay you a course, they do it out of good will, if you need it (GFC, government programmer).

Apparently, this situation highlights a problem regarding the mechanisms of appropriability of knowledge, which is usually associated with intellectual property issues. Linking appropriability of investment in training and that of software is not made haphazardly: the same problems arise when dealing with knowledge as an economic good, only in one case the bearers is an individual subjectivity and in the other it is an informational good. Current regulations and economic difficulties differ in each case, precisely because of the difference in the bearer[xii].

VI
Informal education: modalities, times and attitudes

Undoubtedly, informal education is considered by software workers as the main way for the acquisition of their skills. When consulted about where they got the most relevant

knowledge, only three of our 24 respondents did not mention informal education. Moreover, in additional questions *all* respondents stressed the importance of learning in the workplace. Some of this could be perceived form the quotations placed at the beginning of Section IV.

Now we will try to distinguish the different types of informal education referred. They can be organized around two distinct variables. Does the learning process take place in leisure time or work time? On the other hand, what´s the specific source of learning? The following table gives quotations for each combination.

Table 2
Answers to the question "Where did you acquire the most relevant knowledge for your activity?" related to informal education

Sources	Leisure Time	Work time
Learning by doing	**a.** -I think it´s more important what I I think it is more important for me what I dragged on since my 8 years than the university. -On my own, basically. Doing things, small programs for yourself, not for work. (BA, programmmer multinational enterprise)	**b.** -At work, with trial and error. All the time you are trying out new things, ways to solve something. You look back a job you did and say, did anything. That always happens to me. It's the best way to make it work. (RM, programmer, microenterprise) -…The work is the informal learning. When they ask you to make things you can´t imagine, that´s when you learn" (GCF, State Programmer)
Peers transmission	**c.** -Many people had a lot of patience with me… (TM Developer Free Software) - Well, from known people that taught something to me. Actually, the most important things, I got them from other person. (NE, programmer, microenterprise)	**d.** -We learned Html among ourselves …(MA, Manager, Academic Producction) -…it´s the main learning: look, sit next to someone who really knows and ask questions. I learned that way, I like to learn with examples, ask my work colleagues. (GH, director, empresa multinacional)
Web based learning	**e.** **-…**Now, about the time out of work... Android, but it´s not useful for my job. I use it for my independent activity, I'm learning in forums, tutorials, the web in general. (GCF, State Programmer)	**f.** -Do you use the Web? –All the time –programmers forums, or blogs about open source. (RM, programmer micro enterprise) -Generally speaking, I try to keep myself informed about new technologies, and if there is something new, I go for it. I´m subscribed to forumes, reads, where I get the information. (GD, programmer, in House enterprise)
Bibliographic research	**g.** -When I was younger, there were things in the work that caught my	**h.** -We do our informal learning by reading related materials, that can be both books and articles in specialized

	attention and I used to read about them at home. For instance, I learned everything about Internet that way, my summer reading. (SF, Researcher, Academic Production)	magazines (PH, director, large enterprise) -I have some permanent reference books. For example, there is a very famous book by Eric Gama that is very useful for me. (VR, Programmer, medium enterprise)

The four types of learning identified in the first column have been studied repeatedly for different economic sectors. By contrast, a specific characteristic of software production (and to some extent of the informational work in general) is the enormous weight of learning in leisure time[xiii]. Of course, it must be clear that the complete answers of the respondents usually did not point to a specific box, but to clusters of them[xiv]. Thus, in our Table we have maimed responses to present examples in an orderly manner. Indeed, we believe that the distinction allows us to make some useful considerations that follow.

First, it must be said that the sector **a.** is the most interesting of the table. On the one hand, because, predictably, respondents emphasize the importance of learning outside the workplace. But above all, because for respondents under 45 years (21 out of 24) we observed a clear pattern: those who turned out being programmers usually have had earlier and more intense contact with computers than the rest of their peers[xv]. These experiences vary widely from playing video games, to use for school, parental encouragement, some forms of elementary programming, etc. The differential use may be associated with some separation of generations (always among children under 45 years). On the one hand, older workers were the first computer users in their homes. Their computers were purchased specifically for children (and) entertainment[xvi]. On the other hand, younger people usually benefited from the knowledge of their and parents, who used the computers for work[xvii]. In all cases, the recreational use was hegemonic, although in some instances certain forms of programming were present early[xviii]. In turn, exploratory uses -an attempt to repair any program or joining the first computer networks- have been recurrent[xix]. Everywhere, the relationships between children and digital technologies were, in sociological terms, consummatory and not instrumental.

Thus, the learning process was not planned with a rational purpose. Such links between children and computers did not arise in the context of courses or any other institutional arrangements, aimed to raise certain skills -as occurred for the same generation with learning a foreign language or a musical instrument-. They were built from fragmented experiments and without a predetermined path. Strikingly, or not, these consummatory and partially chaotic links have sprung in the most valuable knowledge fruits, according

to our respondents. Yet, none of the programmers interviewed had learned (in their childhood) computer languages or specific applications that remain useful today. Rather, they acquired a habit of exploration, a set of meta-skills to solve problems that allow them to adjust for dynamic and unstable situations. In this sense, *it seems feasible to hypothesize that early socialization with informational goods helps greatly to configure certain generic capabilities that after can be translated into specific programming skills.*

Of course, this idea is neither new nor restricted to the socialization of the programmers. It has implications for all forms of informational work and, to some extent, it has inspired the massive programs for distribution of netbooks, being developed in many countries. Further elaboration is required at least on two issues that remained unexplored in our research: i) the relationship between early socialization with digital technologies and the technical level that is acquired later. ii) the specific characteristics, if any, of the households that stimulated the link between infants and informational goods.

Secondly, we must mention the workplace informal learning region, given by the conjunction of the boxes **b.**, **d.**, **f.** and **h.** As noted above, all respondents emphasized the learning that occurs informally in the workplace. This usually refers to a combination of peer consultation, web browsing, and experimentation. However, the most common situation that results in informal work learning, seems to be *the need to face new problems*. For example:

- The nightshift implies a very forced learning. They call you at 4 am and say, hey man, fix it! You have 4 hours to solve it, and you get mad. If it turns out well, you don´t forget it (ML, programmmer multinational enterprise, in house)

-… Confronting new problems with the necessity of solving them. (RA, director medium enterprise)

-You´re always learning. When I can´t fix something with the usual tools, I search for something new. Everytime you have to learn to find the better solutions. (SC, programmer micro enterprise)

Third, we have the row comprising the boxes **c.** and **d.**, i.e., learning through-known peers (as opposed to the anonymous members of forums and the like). This modality is highly valued, both within and outside the working day. Contrary to the usual representation of software workers as solitary and asocial human beings, in our interviews the peers exchange, and even the integration of communities or networks emerged clearly. Naturally, the precise form of the learning among colleagues varies according to type of production process: it is quite different between Free Software

developers and the members of a multinational company. However, in all these processes (and others) we have found evidence that highlights peer exchange, and even face to face learning.

Fourth, we find learning through the Internet. This method involves in turn a variety of heterogeneous media. Our respondents use search engines, forums, blogs of developers, consultations by email, mailing lists and more. The valuation of these different sources is by no means coincidental. For example, while in the box forums appeared prominent, NE criticizes them:

> -I don´t like forums very much, nor tutorial. I´m not the kind of person who watches tutorials. I like to dig in specializaed pages, those of the developers, where they explain their applications, their tricks. –And why you don´t like forums? –I don´t know, I´m not used to them. I guess it´s because anyone can write an opinion. So, when you read, you´ve to filter a lot. Always there is something valuable, but forums are not something to be enthusiastic about.

In any case, the exploitation of digital information flows circulating in the Internet is a constant for all these workers. Since in almost all cases we interviewed they are greatly benefited from free digital information flows, it would be interesting to investigate, conversely, on the extent to which they contribute to these areas: post on blogs, forums, share code, and so on. Unfortunately, this issue couldn´t be addressed by our research.

Fifth, and although it is a modality that is mentioned only by a few respondents, we must mention the role of traditional literature (books, magazines, academic papers). It is without doubt the least important of the above. While some interviewees mentioned as a relevant source, it must be said that as many choose to undervalue this source explicitly. Not surprisingly, among the former we find those who have bachelor degrees and among the latter those who do not, but no linear conclusions should be drawn.

Finally, it is worth pausing to consider a set of informal techniques that we have not addressed yet, but have a great impact on software production processes (and in the of informational capitalism in general). These are the *attitudinal skills*: those relating to character, style, interpersonal and communicative habilities, etc.

We have tackled some of them when discussing Non Formal Education. Certainly, firms offer a wide range of training courses to develop those skills. In turn, it is clear that many of these techniques relating to the character are acquired in informal, tacit and

unconscious ways. But by its very elusive nature, they are difficult to place in a given quadrant. Undoubtedly, this kind of learning occurs in the relationship between peers within and outside of work time (c and d), but also in learning by doing (c). To a lesser extent, some of these techniques can be grown using different types of information (e, f, g and h). In any case, the key point is that while we can not say how these attitudinal techniques are informally incorporated, we can underscore the great importance given to them by the interviewees. In short, there are three axes to group around the most frequently mentioned attitudinal techniques.

An axis is related to *sociability* with peers, superiors and clients; this involves communication skills, ability to work in teams, to exercise soft power over other members of the production process, etc. These skills are by far the best ranked among our respondents[xx]. More specifically, software workers and managers are aware of the prejudice (shared or not) against their sociability and therefore consider the linking capacity as something highly valuable[xxi]. Sometimes, the social attitude refers to the link with customers, in different ways[xxii]. In cases of those who assume hierarchical roles (in different kinds of enterprises), the meaning of these skills slips into the practice of coordination and power[xxiii]. While this first axis is common with many other economic activities, the other two are more specific to software production.

Thus, the second axis about important attitudinal techniques is focused on *creativity, initiative, proactivity*. Our interviewees agree that their job requires a kind of calling; a deep involvement with the production process, or some of it[xxiv]. The third axis, finally, concerns the ability to *persevere in a task*, to keep the self-discipline and the organization of work; to the ability of overcoming frustrating situations that frequently arise in informatics[xxv].

Conclusions

Software productive processes are a heterogeneous and dynamic object, this makes its understanding complex. One can verify this, specifically, regarding the forms in which informatics workers acquire their techniques. In this sense, data and hypothesis we´ve presented here are dated, and will become obsolete in short time. All in all, we can recap the findings we´ve achieved along the way.

Software productive processes can be framed within the information sector, which exceeds them widely, and includes every activity that has as a primary result

primary informational goods. The activity of those who produce those informational goods (within the information sector, but also in other sectors) is called informational work, and presents certain characteristics which distinguish it from agricultural, industrial and service work. One of these characteristics, in which this study focuses, is the one related to the relative weight different types of education have in informational work. Following Education Sciences literature, we define three types of formal education: formal, non formal and informal. Taking these categories into account, we interrogate our interviewed, city of Buenos Aires informatics workers.

Our findings on *Formal Education* indicate, in partial coincidence with previous literature, that this type of education is not of great importance in the representations of the interviewed workers. When explaining the origin of most relevant techniques, formal education tends to be poorly ranked by those who have deserted from it, but it´s neither highly valued by most of the degree possessors. The same occurs when we inquiry on what types of knowledge had been required when applying for productive processes which concern us: both employers and applicants relegate formal education and, specifically, possession of degrees. However, this may vary according to the type of productive process. In some cases bigger companies demand, especially for certain positions, some kind of formal qualifications. Of course, these positions are the most desirable ones, in hierarchical and salary terms. In a wider sense, degree possessors obtain, on average, better income levels than non possessors. The partial disparity between representations regarding *origin of techniques*, and the objective situation which takes place on productive processes can be explained partially with the following hypothesis: *transit through higher education provides other forms of knowledge which are not techniques but are highly relevant when trying to make a favorable insertion in the work market*. Maybe the main of theses forms of knowledge is the insertion in a contact net and recognition. Future research will have to address this matter.

Regarding *Non Formal Education*, we´ve analysed the relevance courses, capacitations and certifications have, as defined previously. In terms of representation, non formal education is the least valued of the three types when referring to the origin of the techniques workers possess. However, this doesn´t mean that our interviewed have not taken courses and capacitations, or even that in objective terms theses educational modalities aren´t relevant. The most interesting of the three types of non

formal education is certifications, which emerged as guarantees in private activity, given the limitations of formal education. Our tentative conclusions on certifications are these: i) It seems they are objects strictly related to large or multinational companies. ii) Despite interviewed workers who took this courses not being in the productive processes in which they desired to be, ranked them taking into account its guarantee quality, it isn´t certain that this credentials are particularly relevant to gain entry into companies. On the contrary, in some cases techniques provided by those expensive courses may be the ones that become crucial to gain entry iii) However, once workers are inserted in these companies, certifications seem to be useful in the companies´ perspective not just to pass on knowledge (this as capacitations or courses) but also to signal workers. On the other hand, capacitations and courses are largely more frequent than certifications. With no surprise, both, but mostly capacitations, preponderate in larger companies. In some cases, appropriability problems appear regarding the investment that productive units make in the different forms of non formal education. It seems it´d be of importance study theses problems, related to knowledge carried in workers´ subjectivities, together with difficulties related to appropriability of knowledge in other bearers (as in digital information, technologies, etc.) from an intellectual property perspective.

Finally, Informal Education is, beyond doubt, the most relevant when referring to workers perspective. It frames a group of diverse forms which, as a starting point, we choose to organize surrounding two centers. The first one is if this learning occurs during work hours, during leisure time or both. The second one is related to four frequent forms: learning by doing, consult between peers, net research, and bibliographical consult. Naturally, the answers given by our interviewees did not coincide with a unique choice, but with several of them. All in all, we present some regularities we´ve observed: One, when referring to practical learning taking place outside work hours, it is fundamental to highlight the presence of informational goods during childhood or puberty of those who´ll end up to be informatics workers. None of the interviewees learned during childhood computer languages or specific apps that remain useful today. We must say they acquired an exploratory habit, a group of meta-abilities for problem solving which allows them to adapt in an unstable and dynamic context. In this sense, the hypothesis which supports that early socialization with informatics goods allows to build up certain generic abilities that later develop into

specific techniques. Two, we must mention that all the interviewed workers highlighted the importance of informal learning in the workplace, with its different modalities. Learning born out of the necessity of solving problems seems to be of great importance. Three, our interviewed workers seem to think that attitudinal techniques are largely important in software productive processes. The most named ones seem to be related to three categories: i) Sociability (communication, peer relations, capacity to coordinate and to apply "soft power") ii) Creativity (initiative, enthusiasm, pro-activity) iii) Organization (perseverance, being systematic).

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Endnotes

[i] This study is part of a wider investigation titled and framed by the Institutional Recognition Project in the Faculty of Social Sciences at Buenos Aires University (UBA) RIO_279. The research team members are Lucila Dughera, Hugo Ferpozzi, Nahuel Mura, Agustín Segura, Guillermina Yansen and Mariano Zukerfeld. More information related to this investigation can be found at: http://trabajoinformacional.wordpress.com/

[ii] The field work done within this study consisted of 24 in-depth interviews to software producers, and an in depth interview with a key informant. This took place in the City of Buenos Aires, during September/December 2010.

[iii] For more information, see http://ec.europa.eu/dgs/education_culture/index_en.htm

[iv] In this article, we refer specifically to the certifications obtained by workers individually. There are other certifications related to software productive processes, as the CMMI or IRAM/ISO norms, but we won´t approach them within this article.

[v] The survey was done to 169 informational workers. Unfortunately, we don´t have access to the data concerning the utilized sample technique or other methodological specifics.

[vi] Informatics Engineering, System Engineering, Systems Bachelor, Computer Science Bachelor, System Analyst, Telecommunication Engineering.

[vii] This can also be observed in previous interviews done by Agustín Segura:

- "When you are incorporated, they make you take a test, programming test, English and… a logics test. Maybe you are not in college, but you pass because you´ve been programming your whole life and maybe they hire you all the same, what they are concerned about is if you know how to program and if you handle the language fairly". (Leandro, en Segura, 2010:62).

[viii] Which includes software producing companies, but also those which produce other service and goods; and state.

[ix] As it was put by one of the interviewees: "University seems useful because you are with people with whom you can discuss these subjects" (CA, large company researcher)

[x] Several illustrative answers for this question, which put light on diverse forms of informal education, can be read in the previous section, and it´s senseless to repeat them here.

[xi] Even more, among those who didn´t pay for their certifications on their own, several say that if they had had to pay for them themselves, they wouldn´t have applied for them.

> -It was given by the company. They were expensive courses. (RA, Socio gerente en empresa mediana)
>
> -5 thousand (the one on SCCM) and 3 thousand. I don´t think i´d ever pay for such nonsense, it´s too expensive. (ML, Programador, empresa multinacional)
>
> - I made the courses but i didn´t take the exam. The cost was too expensive. (GD, multinational company programmer, in house software production).

[xii] For deeper approach on the relation between different types of knowledge bearers and capitalistic regulations, vid. Zukerfeld, 2010a.

[xiii] Naturally, dissolution of the division between work time and leisure time, as mentioned by, for example, autonomist authors (e.g. Lazzaratto y Negri, 2001; Virno, 2003) describes accurately what occurs with most of our interviewees. Let`s analyze now each category.

[xiv] The typical example of an answer when asking for ways for informal learning is as it follows:

> - Peer consult, sit down and see how it works, search the web for solutions. One can also learn from reading papers. (CA, large company researcher)

[xv] The typical example of an answer when asking for ways for informal learning is as it follows:

> - Peer consult, sit down and see how it works, search the web for solutions. One can also learn from reading papers. (CA, large company researcher)

[xvi] In this sense:

> - It was with a 64 commodore that my father bought for the house. I was around 8 years old. My old man didn't use it. (G.H., age 33)
>
> - It was a Talent MSX around year… i don't know, 88, (…) fifth, sixth grade, I don't remember. In the Commodores times, and those machines, they bought me a Talent, it wasn't the most popular model but it was one of the computers of the moment, and then I started – Was it bought for you? – It was for me and my brother (…) to play, because of the games, we were around eleven. We played Prince of Persia, Galaxy…No, Prince of Persia was with PCs already, I don't know, I can´t remember anymore (…) The only ones who used it were my brother and me. No one else. (N.E., age 33)
>
> - Around 8 years old. They bought me a 64 Commodore. – What did you do with it? – With that computer? I didn´t have a clue. (DBJL, age 32)

[xvii] For instance:

> - My dad is a UTN systems bachelor, so at home there were computers all the time. I got into it, learn DOS quickly and I also started to investigate, I liked it. (V.R., age 26)
>
> -Commodore 128, playing batman games with a 5 n ¼ diskette. I was 4. My father worked with it and i played. (G.F.C., age 23).
>
> -My parents used it. They were always into computers, they´re engineers, they´re in the subject; they had it as any other thing in the family, like a TV, a family thing. My brother was bigger and he used it and he ended up doing the same thing my parents did. Mi brother had a really big influence on me. (GRT, age 27)
>
> - With my old man´s notebook when i was little. Seven years old. (…) He´s a systems analyst, he had clients (…) He used to run games for me and i killed time like that. (RB, age 23)

-Mmm… i don´t know how old i was but i don´t know, around ten years old (…). My father bought a computer, the first one we had (…). I had a friend who played games (…). My father [used it]. Besides me. Mostly for work. (…) He did marketing. (BA, age 27)

[xviii] Besides the quotes of the last two notes, the combination of games and programming can be appreciated here:

- I started playing games in my Commodore. Afterwards, when i was around 14, I started to make programs with Qbasic. Based on magazines I found at home. And books. I was into informatics security, hackers, all that, cryptography, viruses. (O.J., age 28)

- Through video games. Videogames and well, afterwards trying to mess with videogames, modify them…When I was around 14, 15. (M.L., age 27)

-I used it for games and to learn how to program, my dad wrote. My brothers used it for games. My mother didn´t use it. It never caught her eye. (C.A., age 34)

[xix] In this sense:

-…touching here and there, maybe you break something, and afterwards nothing worked. Maybe my dada came and said "nothing works, what did you do?" and somehow you try to fix it, and you start to learn like this. I mean the fixing part to say it somehow. And afterwards, you get into the programming part. Not until high school I started to get into programming. (BA, age 27)

- And afterwards touching, fooling around with the computer, internet and stuff. I was mucho more into computers than…well, games, or internet, researching. Reading stuff, I don´t know. (M.A., age 26)

- When 15 they gave me an IBM activa. I started to use it…I never played games, I get bored. At first I did school stuff. I was the only one who handed her homework printed. Short after the VIVA magazine came out with a piece on BBS…While my parents where asleep I got online. And it said the name of a club…Dr Jekyll, it must be that club. And there was this boy, when I sad I was a girl, he fell for me, and he called me on the phone. - Are you a girl? Get back online. That guy was pretty deep into it. And he told me "you have to get into the internet" And he gave me some code, and I went online half an hour per day. (T.M., age 29)

[xx]For instance:

-To me, companionship is fundamental; capacity for relations; the interest for group work , (RA, Partner/Manager in a medium company)

[xxi] In this sense:

- Being able to relate to lots of people with social incapacity, who don´t know how to behave, who don´t respond to social conventions and are hard to deal with. (CA, large company, researcher)
- Abilities to communicate, especially in relating to people, knowing how to treat people. In this area there´s some sort of stigma, we are usually seen as freaks. In my case, i try to pay attention to the necessities of partners I'm working with. (GD, programmer for a multinational company, in house production)

[xxii] In this sense,

- Interpersonal abilities are fundamental. One has to know how to communicate, know how to talk to people. Always respectful and honest. That is fundamental. Even when you have

to give the worst news, always in a good way, and, yes, with good humor, with a straight face. (VR, programmer for a medium company).

- Being able to sell smoke and mirrors is an important ability, its basic on systems, promising that you´ll do, and then well, you kind of roll with it. (GCF, state programmer)

[xxiii] For instance:

- You need character for imposing ideas in a discursive manner, the psychology side of it…(ZA, large company manager, in house production)

-Tolerance, learn how to open your eyes and look around, to know how to admit mistakes, express what the other one did wrong in a positive manner, be one step ahead. To give an example, there are attitudes you need to moderate. Restrain your language.(RB, manager/partner on small company)

- They require me all the time, in my case what is expected is for me to have the ability to form work groups, problem solving groups, to coordinate them. (GH, multinational company manager)

[xxiv] For example:

- Being open to ideas, the most important one. Being a person open to think things in a different way. Kind of a mix between open and creative, really close. (CA, large company researcher)

- You have to have that dynamic, when a problem arrives, to be creative to solve it with what you have. Not to freeze with all the missing things, and move to see how you get those things. Proactivity they always show. I think that with a little creativity you can solve lots of things. (MA, multinational company, DBA)

-And finally, being extremely curious. We read an amount of information during the day that people doing other kind of work never do. (TM, Developer software libre).

[xxv] For instance:

- Being tidy with your personal time and knowing how much can one do in a certain amount of time is fundamental, to establish deadlines, i can or I can´t do it for tomorrow-(GCF, Estate programmer)

- Being patient, being ordered, being organized. Constancy. Working when you have no pressure. (RM, micro company programmer)

- The capacity to sit down and be several weeks focusing into a specific thing and solve it. (CA, large company researcher)

-Perseverance: because it´s full of this things, you do something, some error comes up and you have to test it, see where you put what, and until you get it…(NE, small company programmer.)