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Enlightening the pre-implementation of a digital tool and anticipate individual change by analyzing the activity.
An illustration through the activity of French teachers-researchers.

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Abstract:
The digital transformation of organizations is bringing changes both at the level of work and at the level of individuals. The purpose of this paper is to examine the individual impact of a combination of policy changes and technological and digital breakthroughs. More specifically, it attempts to answer the following question: how to respond to ministerial and institutional impulses requirements in terms of digital strategy and the adaptation of pedagogical processes? By analyzing the associated activity, we propose to shed light on the pre-implementation of a new digital tool and to anticipate individual change. An illustration by analyzing the teaching activity of French university lecturers-researchers allows to highlight the key factors that influence their perception of the individual change induced by the activity. We thus propose to shed light, by analyzing the activity, on the pre-implementation of a new digital tool and to anticipate individual change.

Keywords:
Digital Transformation - Theory of Activity - Individual Change - Teacher-Researcher - Activity Analysis

Introduction

The digital transformation of organizations is bringing changes both at the level of work and at the level of individuals. The activity of the actors is modified and becomes a source of potential learning, by its dynamic of encounter between an individual and a context (Rabardel, 2005). In a context of digital transformation of work, the actor is facing a redefinition of his activity. The great theories of learning (Piaget, 1974; Vygotski & Piaget, 1997) allow to characterize the impact of a new tool on the individual learning of the actor and on the determinants of behavior (Cooper, 1993). to answer to a new situation mediated by an instrument, the individual will tend to an individual cognitive progress (Piaget, 1974) by joining a community of work (Engeström, 1999) where social relations are particularly vectors of understanding the action (Vygotski & Piaget, 1997). The theory of activity (Engeström, 2000) can shed light on understanding the interactions between actors and technology in a unified vision of technology and activity (Karanasios, 2018). Drawing on the psychology of development, cognitive ergonomics and professional didactics, activity analysis focuses on studying work activity for the personal and cognitive development of individuals.

In recent years, the digital transformation of work is part of the strategic impetus of the Ministry of Higher Education, Research and Innovation1, following the law of July 22, 2013, which places digital technology as the "lever of a university in motion". Four ambitions are put forward, the first of which positions digital technology to serve students' success and the second which distinguishes digital as a tool for the renovation of teaching practices. Technopedagogical devices transform the conditions of exercise of the profession of teacher-researcher (Peraya, 2015). The use of new technologies to teach leads to changes in the activity of teacher-researchers and questions the resulting individual impact and commitment to institutional requirements.

The purpose of this paper is to examine the individual impact of a combination of policy changes and technological and digital breakthroughs. More specifically, it attempts to answer the following question: how to respond to ministerial and institutional impulses requirements in terms of digital strategy and the adaptation of pedagogical processes?

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[1] http://www.enseignementsup-recherche.gouv.fr/cid89439/le-numerique-au-service-d-une-universite-performante-innovante-et-ouverte-sur-le-monde.html

We propose to clarify, using the principles of activity analysis, the pre-implementation of a new digital tool and to anticipate individual change. The first part will first cross two visions of the digital transformation of work with regard to individual learning and then the determinants of behavior. In an activity analysis approach, the second part will define a conceptual framework. Finally, the third part will offer an illustration by the activity of teacher-researchers.

1. Crossing two visions of the digital transformation of work: individual learning and behavioral determinants

The evolution of activities related to digital is important and affects all forms of organizations, potentially leading to a transformation of actors. The impact is twofold: it affects individual learning (1.1) and the determinants of behavior (1.2).

1.1 Impact of digital work transformation on individual learning: ownership and adaptation competency

If we are interested in the effects of digital transformation on the actors of an organization, a first vision of the impact of this transformation can be approached from the point of view of individual learning and appropriation (De Vaujany et al., 2009) and in the user-technology relationship, the individual impact can be understood from three points of view: technocentric, sociotechnical or sociomaterial (Orlikowski, 2007, 2009). The technocentric vision sees the technical object as structuring and modifying factor of the human behavior (Amalberti, 2001a, 2001b). Ownership is then a process by which individuals incorporate advanced technologies into their work practice, an adaptive process from tool to use (De Vaujany et al., 2009). The socio-technical vision conceives an interdependence of technical and social systems as well as a joint optimization of the two dimensions and their relation (Plane, 2012). The appropriation is then a taking possession of the technology by the user, an identification of the technology (Barcenilla & Bastien, 2009; Gaskin & Lyytinen, 2012). The sociomaterial vision privileges neither the human nor the material nor their relation, but takes into account a reciprocal entanglement (Orlikowski, 2009). Ownership is then a combination of managerial flexibility that changes behaviors supporting an idea of innovation (Alter, 2015; Daniellou, 2004; Daniellou & Rabardel, 2005) ; and instrumental flexibility that turns the technical tool (Akrich, 2006; Bourmaud, 2013).

By placing ourselves in this sociomaterial vision, we can conceive the appropriation of a new digital tool for the user such as the transition from an artifact to an instrument (Rabardel, 1995).

The change of technology is then interpreted as a moment of learning by instrumental genesis and affordance (Gibson, 2013) on the condition of taking the instrument-operator or actor-object relationship as an entanglement where each contributes to changing the other, transforming itself (Bourmaud, 2013; Rabardel, 1995). The importance of reflexivity comes into play in this dynamic of learning and skills.

The implementation of a new digital tool in the professional environment then took place potential development situations (Mayen, 1999), professional situations where the operator transforms his repertoire of skills to adapt to a new professional condition. Moreover, for Pastré (2005), The dynamics and metamorphosis of professional skills follow the evolution of work and we see a shift from an execution skill to an adaptive skill. The skill lies in the ability to adapt (Pastré, 2011). By always going further and keeping the idea of sociomatériel entanglement, we can also analyze the skills necessary to know how to adapt and this even beyond the individual, to favor an organization capable (Falzon, 2013; Mollo & Nascimento, 2013).

1.2 Impact of digital work transformation on the determinants of behavior: from intention to capability

The impact of the digital transformation of work can also be approached according to a second vision, that of behavior and especially the intention to behave. In cognitive psychology, we consider that mental representations and perceptions influence the intention to behave and then the behavior.

So the theory of reasoned action Ajzen (1991) characterizes the intention as preceding the behavior. This intention is determined by factors internal to the individual (expectation and perceived effects) coupled with external factors (influence of social norms). For Vroom (1964) or Bergeron (1979), the individual is motivated by his expectations and the chances of attaining them. Expectations theory determines a level of motivation by the equation VIE (Valencia Instrumentality Expectation) = (Am I able?) x (What am I going to get?) x (What value for the benefits obtained?).

In a more sociocognitive approach, Bandura & Locke (1977, 2003) emphasize the importance of individual factors of intent that lead to behavior. The behavior towards a new technology is then no longer guided solely by the expected results but also by the individual perception of its capacity. The sense of self-efficacy then acts as a determinant of commitment.

This representation of competence for the individual as a vector of action can be deepened by the capacity-based approach. The central point of this theory rests on the idea of the ability of individuals to be able to do something - the power to be and the power to do (Sen, 2009). This theory links the notions of freedom and autonomy with the capacity to act. Capability then highlights the act in situation and mobilizable skills of the individual, as well as the constraints and opportunities they have to act (Corteel & Zimmermann, 2007) and thus slip into the notion of enabling environments to implement behaviors expected by the organization (Falzon, 2013).

It is in this rich and dense theoretical context that we propose to synthesize a conceptual framework through the analysis of the activity.

2. An approach by analyzing the activity: definition of a conceptual framework

From the work of Vygotski (1934-1997), the theory of activity (Engeström, 1999, 2000, 2011) focuses on characterizing a conceptual framework for studying human practices as a process of development. It presents a set of tools to report on the activity in its complexity. It establishes a heuristic model that makes intelligible the components of human activity mediated by artifacts in a defined context and the conduct of joint collective activities. Human activity is modeled as a system that associates individual and community because "he mobilization of the activity makes it possible to define at a time T the components of the activity (the elements of the systemic model), to grasp its interrelations as well as the emerging contradictions, with a view to the development by expansion of the committed systems. [...] It invites to a study of the activity being done" (Durand & Barbier, 2017, p. 499). In this system, it is therefore important to analyze the interrelationships between the activity system itself and the system of activity included in its organization, the theory of activity suggesting that the interaction results from technical and psychological tools. that actors use to interact with their environment (Engeström 2000).

In this general theoretical framework and by integrating the concepts of Information Systems (IS) and Human Machine Interface (IHM), the analysis of the activity can then be defined as "a coherent system of internal mental processes, external behaviors and motivational processes that are combined and directed to achieve conscious goals" (Bourguin et al., 2005, p. 7). The activity is approached as an intermediate concept between the study of the social system (context) and the behavior (individual) to study the mediation by the tool. The approach of the

activity can also be understood from different angles depending on the field of practice, including professional didactics, constructive ergonomics, or enaction. These fields of practice are neither totally similar nor fully diversified. The basic conceptual bases overlap partially, under different semantics, the notions intertwine and complement each other. From the action and based on the theory of activity, these visions are differentiated only by their polarization but all "interested in joint transformations of activities, topics in and through their activities, and organizations" (Durand & Barbier, 2017, p. 3). For exemple:

- Professional didactics (Pastré, 2011) focuses on the analysis of the work for the personal and cognitive development of the agents, with a view of the development established from the point of view of the activity (in this case the professional activity) and from the point of view of the development subject (more precisely the development of his skills).
- Constructive ergonomics (Falzon, 2013) Its objective is the development of individuals and organizations through the construction of the operator in interaction with the world and action on the world to understand or transform it. The activity of the subjects is the engine of transformation, the competence becomes a vector of health and performance.
- The enaction (Weick, 1988) addresses the activity as self-referential where the individual is an actor structurally coupled to the environment, possessing a pre-reflexive consciousness. For Durand et al. (2016), world and actor are a "fact-emerged", responding to the principle of autopoiesis, that is to say the property of a system to self-produce (adapt) to its environment to maintain a state of equilibrium .

We propose to rely on the model of the double regulation of the activity (Leplat, 1997) where "one speaks of regulation, in general, when the recovery A 'of an action A is modified by the results of this one, thus of a effect in return of the results of A on its new unfolding A' " (Piaget, 1975, p. 23). The activity is then defined as a coupling between the situation and the subject, which produces results on the situation and effects on the subject which modify themselves the same situation and initial subject. The activity is then analyzed as a perpetual loop where the subjects transform the activity and transform themselves because of the activity (Figure 1).

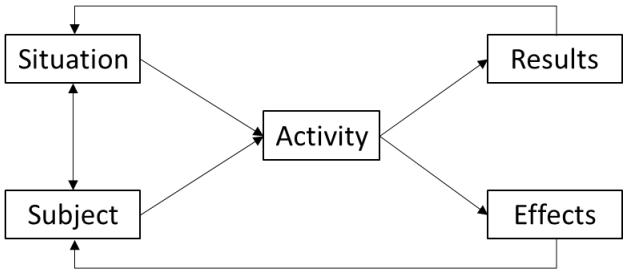

Figure 1 – Model of the double regulation of the activity (Leplat, 1997; Rogalski, 2003)

This model reports on the systemic approach to skills development by modeling individual regulations.

By integrating our analyzes of the impact of the digital transformation of work into the framework of the analysis of the activity, we can present a conceptual framework (figure 2) for our research.

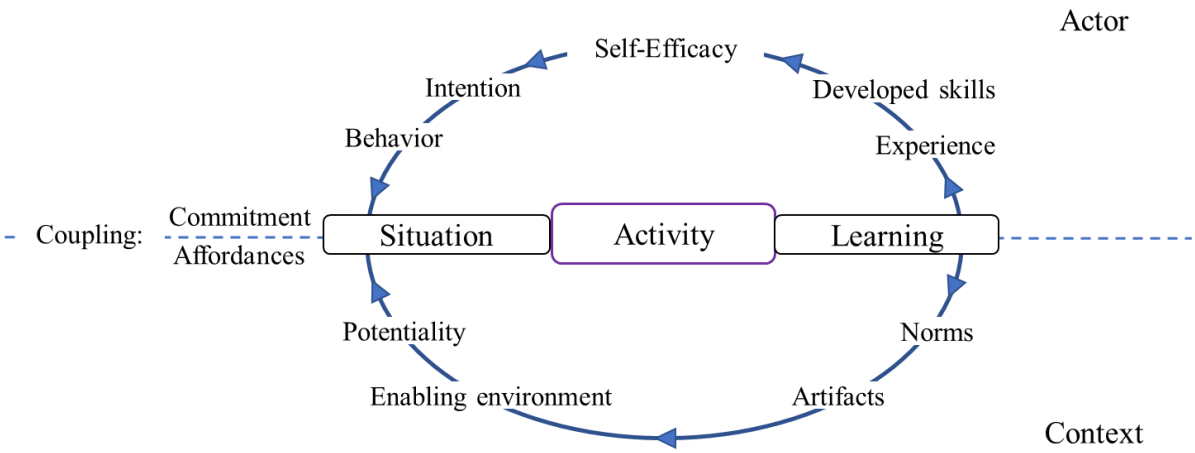

Figure 2 - Conceptual framework of activity analysis

The entry situation in the activity is generated by the coupling between an actor via his commitment and a context via his affordances. This activity is then a learning activity by a double regulation of the determinants of the activity which are internal, specific to the actor and external determinants, specific to the context.

The analysis of the activity of teachers-researchers from French universities illustrates the factors influencing individual learning and the determinants of behavior.

3. Illustration by analyzing the activity of research professors

A qualitative study was conducted by semi-structured interviews with 11 lecturers-researchers from French universities (Table 1). The number of interviews was stopped according to the principle of data saturation (Thiétart, 2014). Saturation was reached at the 8th interview. After transcription, the content analysis (Bardin, 1977) is thematic and lexical (Fallery & Rodhain, 2007). The main objective was to highlight the factors of the activity which influence the actors in the realization of this one. The profession of teacher-researcher (EC) is synthesized into two main categories of missions: teaching and research. We will focus here only on the teaching activity.

ID	Gender	Status	Disciplined	Seniority	Duration
1	Men	MCF	Humanities and Social Sciences	Less than 10 years	35 min
2	Women	PR	Humanities and Social Sciences	20 years and over	46 min
3	Women	PR	Humanities and Social Sciences	20 years and over	36 min
4	Men	PR	Humanities and Social Sciences	20 years and over	33 min
5	Women	MCF	Exact Sciences	11 to 19 years	25 min
6	Men	MCF	Exact Sciences	20 years and over	26 min
7	Women	MCF	Exact Sciences	Less than 10 years	38 min
8	Men	MCF	Exact Sciences	11 to 19 years	37 min
9	Men	PR	Humanities and Social Sciences	20 years and over	41 min
10	Women	PR	Humanities and Social Sciences	11 to 19 years	27 min
11	Women	MCF	Humanities and Social Sciences	20 years and over	46 min
Total : 11	5M 6W	5PR 6 MCF	7SHS 4SE	5 -20ans 6 +20ans	390 min 6h30

Table 1 – Characteristics of the sample

In a first step and in order to obtain a more general characterization of the speech, we realized a lexical analysis with the Alceste 2017 software. This analysis distinguishes 4 classes of speech for 480 textual units of analysis and 72% of the explained variance. The 4 classes update a first representation of the concerns of the teacher-researchers and extract several oppositions (figure 3). Class 1 has a student-centered discourse, Class 2 a discourse centered on pedagogical transformation, Class 3 a discourse centered on the method and vision of teaching, and Class 4 a discourse centered on skills and traits. of personality.

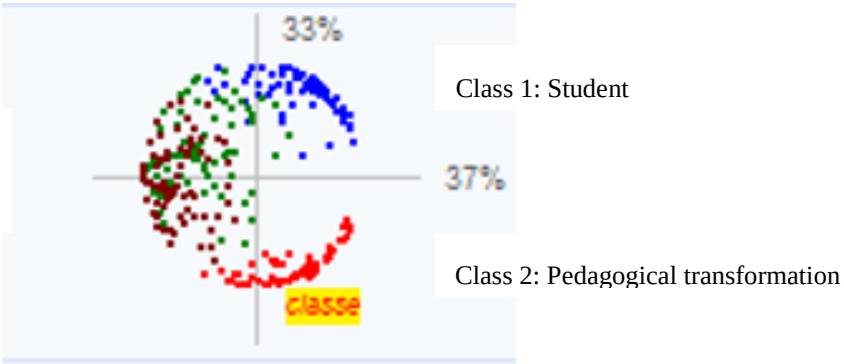

Figure 3 - Lexical analysis: 4 classes of speech

In a second step, the thematic analysis, assisted by the Nvivo 12 software, makes it possible to code 422 references contained in 60 nodes to define the significant characteristics of the teaching activity of the teacher-researchers which one will consider as the factors determinants of activity. We present a mapping of these determinants as part of the regulation loop by subject and situation (Figure 2).

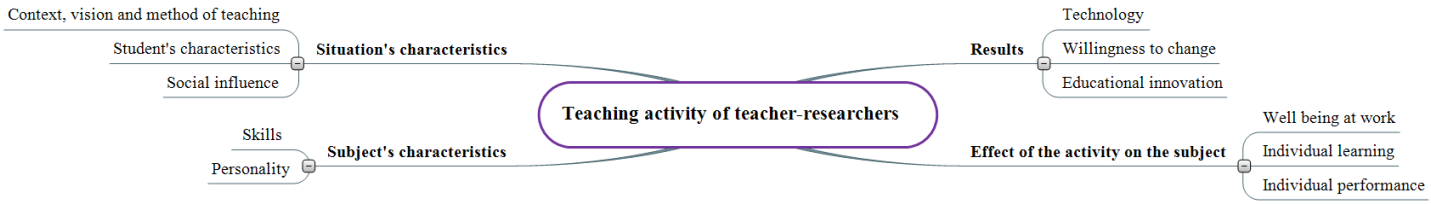

Figure 2 - Thematic mapping of EC teaching activity

From this highlighting of the determinants of the activity, it is possible to envisage the points of impact of a transformation of the activity of the teacher-researchers, with regard to their profession of teacher and to think about the anticipation of the digital transformation of work. We propose the following main results (Table 2) that are illuminated by the literature.

Determinants of activity	The effects of a transformation of activity	How to anticipate the digital transformation of work?
The teaching activity is a source of individual LEARNING.	Transformation perceived positively when the teacher-researcher is VOLUNTARY in the transformation.	Taking into account the importance of the subject actor in the digital transformation of work, the teacher-researcher must be ACTOR of the transformation. (Falzon & Teiger, 1995)
The subject's compelling SKILLS and personality traits influence the vision of the activity and its implementation.	Transformation perceived positively when the skills mobilized for the new activity have already been acquired: the feeling of AUTOEFFICIENCY is necessary.	Taking into account the internal and external vision of the competency that influences behavior, the teacher-researcher must feel CAPABLE in the digital transformation of work. (Bandura, 1977; Nagels, 2010, Sen 2009)
Social and institutional SUPPORT has a sustained influence on the activity.	Transformation positively perceived by a COLLECTIVE PEDAGOGICAL INNOVATION.	Taking into account the importance of social and institutional influence and an empowering organization, the teacher-researcher must feel ACCOMPANIED. (Falzon, 2005, 2013)
The activity plays a role in the WELL-BEING at work and the perceived PERFORMANCE of teacher-researchers.	Transformation perceived positively when it is a vector of individual LEARNING.	Taking into account the close link between health and cognition, the teacher-researcher must perceive his EVOLUTION. (Montmollin, 1993)

Table 2 - Determinants of activity: transformation and anticipation

Based on the determinants of activity defined by the teacher-researchers, it is thus possible to understand the perceived effects of the transformation of the activity and to anticipate the impacts of the digital transformation of work. Ultimately, the teacher-researcher in his teaching activity sees the digital transformation of work as positive when he perceives himself as a capable actor, accompanied in his individual learning. As conceived by the principle of double regulation, the subject transforms activity and is transformed by activity.

In pre-implementation of a new digital pedagogy tool, a strong reflection on these important determinants could positively influence the transformation of the activity. Through the analysis of the activity, we proposed to highlight a conceptual framework integrating the individual learning and the determinants of the behavior.

Conclusion

In this research, we have tried to understand how the analysis of activity can be used as a resource to anticipate the impact of work transformation. The study of the literature on the effects of digital mutations makes it possible to highlight two visions. The first focuses on individual learning, from the concept of ownership to adaptation. The second vision is more oriented towards the determinants of behavior, integrating the notions of intention and capability. With the aim of crossing these two visions of the digital transformation of work, we presented the contributions of the analysis of the activity and proposed a conceptual framework.

From a study of the analysis of the activity of teacher-researchers we defined the determinants inherent to their work situation. These highlighted factors are then those on which any transformation of the activity would have an effect. Thus, a transformation of the activity of the teacher-researchers would have an individual impact on the development of skills, on the feeling of well-being at work and performance. The digital transformation would be associated with a personal desire for pedagogical innovation and change of teaching method, accompanied by a necessary institutional and collective support. In this illustration, we wanted to think about how taking into account the key determinants of an activity, defined by the actors themselves, could make it possible to anticipate the digital transformation of the work from the pre-implementation of a new tool.

Our research has limits that form as many perspectives. This qualitative analysis is an entry point for the analysis of teacher-researcher activity and the individual impact of the implementation of a new digital tool. These first results are intended to enrich a process model for a quantitative study and a study of the intra-individual subjectivity of the transformation of skills. However, the richness of the speech of the teacher-researchers engages a first reflection. It reinforces the conceptual framework and enriches the literature by proposing to cross the determinants of behavior and individual learning through the analysis of the activity; the pre-implementation can thus be considered in a complex analysis. In French higher education, ministerial and institutional strategies are incentives and analyzing the impact of their impulses in the pre-implementation phase could help to characterize the factors of individual commitment.

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