An Integrated Analysis on
the Influence of Online Education on Students' Learning Process

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Abstract

In the context of an abrupt and complete shift from classical to online education, important changes occurred in the dynamics of the educational processes. The sustained online education forced all the involved actors (students, instructors, parents, etc.) to adapt to the new working conditions, and required them quick decisions for adjustments and problem solving, as to ensure the continuity of educational services at an acceptable level of quality.

The online education occasioned by Covid-19 crisis had a significant impact both on form/appearance and content/structure of the learning process, leaving obvious marks of change especially on students and instructors (as the main actors in the educational process). A holistic analysis on the evolution of the learning process in online education conditions is necessary for the proper understanding of the changes that occurred so widely at the students level, since their growth may have been put under high disruptions.

In this paper we analyze existing methodologies and data related to the impact of online education on the students' learning process, and construct an integrated analysis framework (based on the students' management of Information-Skills-Attitudes/ ISA) that approaches the subject holistically. We validate and complete the theoretical framework with relevant data that we gathered in two practical research studies related to the evolution of students' well-being and acquisition of skills in online education.

In the end, we present the ISA integrated analysis framework populated with the data obtained, thus offering a relevant overall image on the factors that impact the students' learning process in the sustained online education. The paper concludes with open matters for future research, that would set the path for refinement and calibration of the findings, according to specific educational needs.

Keywords

Online Education, Learning Process, Integrated Analysis, ISA Framework

1.   Introduction

The influence of online education on the learning process has been studied in the last two decades, but only by tackling some punctual contexts or possible scenarios meant to improve classical education by the means of the digital technology. As well, some educational institutions tried to offer more flexible services to their students, in order to enhance the learning experience, to attract better talents and to provide a more proper insertion for the graduates into the workforce field.

The Covid-19 pandemic context (in between 2020-2019) acted as a game changer on the educational process worldwide, bringing serious challenges to all involved actors (students, instructors, academic management and auxiliary personnel, parents), to adapt their decisions, actions, habitudes, tools, interaction and support for the full online education context.

Apart from the didactic implications, the students and the instructors needed to struggle with emotional difficulties generated by the change in the interaction dynamic, the lack of physical social contact, the lack of classical educational context, the solitude and other variables that influenced – directly or indirectly – their availability, balance and capacity to sustain the educational process in the online context.

A holistic approach is needed to analyze the influence of online education on the learning process, especially in these unprecedented conditions marked by a full and abrupt shift from physical to online context, that did not let too much space for adaptation.

Overall insights on the influence that online education brought on students' learning process facilitate the understanding of the requirements that the academic actors should take into consideration in order to calibrate their decisions for improving the current educational process and the future blended learning conditions (that will emerge inevitably after the Covid-19 pandemic crisis).

2.   Research Objectives

This study was constructed on the margins of the following objectives:

i.   To understand the status of the previous theoretical insights on the implications of online education on the students' learning process.

ii.   To discover the proper ground and perspectives that would facilitate an integrated/ holistic analysis on the influence of online education on the students' learning process.

iii.   To propose an integrated analysis framework on the influence brought by the online education on students' learning process.

iv.   To compare, validate and complement the insights of the theoretical analysis, by the means of practical research.

v.   To substantiate decisions for adaptation of the learning conditions, both for students and instructors, as well as for the education institutions and systems level.

3.   Theoretical Framework

The Learning Process

Learning is an "ontogenetic adaptation that involves the generation of changes in the behavior of an organism, as a result of regularities [persistent, regular influences –Ed.] of the environment in which it evolves." [De Houwer, 2013, p.631]

We understand that, *from a scientific perspective*, learning is a complex process, performed by organisms for (evolutionary) adaptation to the persistent influences of the environment in which they live. In the case of humans, learning involves the development of internal processes, both physical and psychological, which allow adaptation to environmental conditions.

In this context, we notice at least two important aspects for our work:

- For people, learning can be understood:
  - both from the perspective of theories of human growth and development (of a psycho-biological nature), in order to follow the long-term evolution of the individual, as an organism. (see, e.g., J. Piaget's theory of intelligence development [Piaget, 1999]).
  - as well as from the perspective of the theories of formative content and information processing, in order to follow the evolution of the social individual, on medium-term

(as is the case of formal educational cycles) and long-term (in the situation of lifelong learning). These approaches are known in the literature as *learning theories*.

• Complete online education, which took place for at least 1.5 academic years in between 2020-2021, is a context with persistent action that has generated in students a need for ontogenetic adaptation.

In order to follow the dynamics of the influences brought by online education on students, in this paper we will make a segmentation of the learning process in stages of evolution/ manifestation (by reference to the understanding found in established scientific theories, related to human development and training), that would facilitate the extraction of detailed information, relevant to the needs of practical use.

From a technical/ applied perspective, the educational process aims to acquire learning outcomes – knowledge, skills, attitudes – that provide people with the means necessary for personal fulfillment, for creation of healthy and sustainable living conditions, as well as for adaptation and contribution to the social context [European Union, 2019]. This strategic vision is the basis for guiding and planning community resource management efforts in order to implement educational policies and develop efficient, coherent and inter-compatible education systems.

From the scientific perspective we can obtain a physical and psychological description of the learning process (inherent to the individual), while in the technical/ applied approach we can find landmarks of practical use of educational content, useful to meet human needs, as well as social and environmental issues. From scientific descriptions we can easily extract and understand *the stages* of the learning process, while through technical / applied approaches our attention is focused on *the dimensions* of learning, which can be shaped by decisions, management and educational context.

In this paper, we focus our study efforts on exploring both the psycho-educational landmarks of learning (structured in learning *stages*) and the practical aspects, centered around the *dimensions* of learning (informational, skills and attitudinal). The two ways of structuring and describing (i.e. in stages and dimensions) represent a foundation for the analysis model developed in this paper, in order to holistically understand the evolution of students' learning in the context of online education.

Stages of the Learning Process

The learning process – that supports the acquisition of the learning outcomes – involves the students implication in sustaining and passing specific educational activities. In the scientific literature we may find a multitude of learning theories, which describe various ways of conducting the learning process. Table 1 below lists, centralizes and synchronizes the stages of the learning process (following a common logical structure), as they are perceived in some of the best known theories of learning:

Learning theories	Stages of the learning process						References
Behaviorist		Response to stimuli	Repetition	Learning	Adaptation		Guey et al., 2010, p.106-108
Cognitivist	Motivation	Organization	Ordering	Consolidation			
Constructivist	Initial knowledge		Concept development	Testing by application	Conceptualization	Autonomous application	Thomas & Maheshwari, 2017, p. 91
Experiential		Experience	Reflection	Conceptualization		Application	Abdulwahed & Nagy, 2009, p.284
Assimilation		Acquisition	Consolidation	Long-term retention		Forgetting	Seel, 2012, p.325

Information processing		Sensorial acquisition and processing	Information perception and analysis	Decision		Action	Parasuraman & Sheridan, 2000, p.287
Common stages	*Preparation*	*Assimilation*	*Processing*	*Retention*	*Evaluation*	*Use*	

Table 1 – Logical centralization of the learning process stages

Following the analysis of the learning sequences found in Table 1, we identified the common ground that describe the stages of the students' learning process: *assimilation*, *processing*, *retention* and *evaluation* of educational content. In addition to these, we notice the existence of two additional stages, which exceed but come in support of the learning process, as they describe the *preparation* of the learning, as well as the *use* of/ capitalization on learning outcomes.

Students are at a level of human development that allows them to manifest in conditions of autonomy and self-organization, as well as to create and produce novel content at their will [Kamii, 1984]. In these conditions, it is useful to address in our study not only the stages of the learning process, but also the stages of its preparation, as well as the stages of capitalization/ use/ implementation of the learning outcomes – where appropriate – as they can provide benchmarks for confirming and completing the overall reasoning.

More so, holistic analysis of the learning process (which includes, for example, aspects of learning conditioning or preparation) provides knowledge with practical values for actors in education systems, to adapt experiences, decisions and educational management to the (current) online working context and the (future) adapted blended learning.

Stages of the learning process					
Preparation	Assimilation	Processing	Retention	Evaluation	Use
Pre-learning	During learning				Post-learning

Table 2 – Complete stages of the learning process

In our study, the *preparation* stage can be easily included alongside those that mark the learning process, being a potential source of clues about students' states and positions in relation to online education.

Though, the *use* stage is treated with a secondary priority, as it manifests itself later in the process of acquisition of skills and requires careful attention to the long-term evolution of students.

Dimensions of the Learning Process

The literature reveals the existence of three dimensions of the learning process, revolving around the management of *information, skills* and *attitudes*, as follows:

- Theory of information processing states that learning involves the management of *theoretical information*, *information with practical value* and *contextual information* (useful for substantiating and motivating learning).

- Behaviorist, cognitivist and humanist theories (analyzed in a common context) reveal *psycho-motor aspects* (i.e. acquisition of skills), *cognitive aspects* (i.e. acquisition of theoretical knowledge), and *affective aspects* (i.e. mobilization and attitudes) of learning.

- Experiential theory involves an approach to learning from the perspective of *cognitive*, *behavioral* and *emotional stimulation* of human. [Hoover, 1974, p.31]

In addition, technical/ practical approaches to learning (e.g. [European Union, 2019]) aim at developing and adapting educational mechanisms to optimize learning outcomes – knowledge, skills and attitudes.

In order to approach the analysis of the learning process in an integrated manner, we propose a model for a holistic exploration of the three dimensions of competencies – *knowledge, skills, attitudes* – as follows:

A. Management of *Information* – theoretical aspects of learning and cognitive nuances that describe the process of acquiring knowledge.

B. Management of *Skills* – practical aspects of learning and capacity nuances that describe the process of acquiring skills.

C. Management of *Attitudes* – complementary/ supportive aspects of learning and behavioral nuances that describe the process of acquiring attitudes.

In order to be able to structure a logic in the integrated analysis, we follow a series of aspects relevant to the three dimensions of the learning process, in terms of the influence felt as an effect of online education.

It should be noted that in the present study we focus on the learning process (in this case, on the management of *information*, *skills* and *attitudes* – that concern learning at students level), and not on learning outcomes (i.e. knowledge, skills and attitudes – which are acquired contents as a result of the learning process).

The three dimensions of the learning process describe how students manage information contents and materials, how they position and adapt to the limitations of practice/ applied activities, and how they respond emotionally to the educational experience in online conditions.

ISA Framework

Online education involves a great change in the living and working conditions of students, forcing them to adapt to a new behavioral dynamics, to a new didactic environment (at home and – depending on the case – in solitude, with family members or with roommates), as well as to a higher use of the digital technology. In [Popescu, 2020] we mentioned the importance of conducting integrated analyzes on the influence that technology has on man and society, including the implications of the educational process.

For a correct definition of the research direction in this paper we underline the nuanced differences between *learning outcomes* (information, skills, attitudes) and the *learning process* (information management, skills management, attitude management) [Lachman, 1997, p .478]. Learning outcomes are finite objectives, while the learning process is a phenomenon.

This paper aims to analyze elements of processuality, dynamics, evolution, conditionality, contextualization of learning. Understanding the essence of the learning process involves identifying and defining its component elements, as well as analyzing their evolution individually, correlatedly (inter-dependently) and in the context of manifestation.

Thus, we propose a model for an integrated analysis of the learning process – named ***ISA integrated analysis framework*** (based on the management of *Information-Skills-Attitudes*) – which consists of:

1. An analysis grid (presented in its basic/ foundational version in Table 3 below and in its final/ filled version in Table 4).
2. A set of sequential analysis processes.

The ISA Grid

The factors under analysis are inserted and centralized in a grid, to facilitate an overall visualization and understanding. The ISA integrated analysis grid provides an overview of the aspects that are important for understanding the dynamics of the learning process, being organized in relation to the *stages* and *dimensions* of learning.

The grid structure comprises the three dimensions of learning (information management, skills management, attitude management), having associated – empirically – specific characteristics for each stage of learning.

ISA grid for an integrated analysis of the learning process

Management of *Information*:

Preparation	Assimilation	Processing	Retention	Evaluation	Use
Curiosity	Reception and perception	Processing and understanding	Retention	Testing/ evaluation	Capitalization

Management of *Skills*:

Preparation	Assimilation	Processing	Retention	Evaluation	Use
Mobilization	Primary interaction	Exploration and knowledge	Understanding of logic	Application	Creation

Management of *Attitudes*:

Preparation	Assimilation	Processing	Retention	Evaluation	Use
Motivation	Openness	Initiative, Will & Action	Awareness	Satisfied emotion	Proactivity

Table 3 – ISA Integrated analysis grid

In the integrated analysis process, the three dimensions contain benchmarks on the influence that the online education brings on the students' learning process.

As a particular aspect, [Eom & Ashill, 2016] findings include also an integrated perspective on the analysis of students' learning process, which we used to complement some of the benchmarks envisaged for the construction of the ISA Integrated analysis framework.

The final (populated) version of the ISA Integrated analysis grid – which can be found in Table 4 – contains modifications, adaptations and additions made throughout the entire documentation and research process.

The ISA Sequential Analysis Processes

The second component of the ISA framework consists in a set of sequential analyzes performed on the collected data (in theoretical and practical research), in order to identify the characteristics and dynamics of the analyzed phenomenon (i.e. learning process), as well as to contextualize it in relation to the frame of reference (i.e. online education, at students' level). The sequential analysis processes include:

- The study of the existing specialized literature, regarding the dynamics of the learning process and its influencing factors.

- Identification and definition of the factors that influence the learning process, as well as of their positioning in the integrated ISA analysis grid.

- Individual and correlated analysis of identified influencing factors.

- Adapted and unitary interpretation of the data obtained, by reference to the subject of the paper (i.e. the context of online education; undergraduate and master's students).

- Validation and completion of theoretical knowledge, through practical research methods, focused on certain topics of particular interest (established as necessary).

- Permanent update of the ISA integrated analysis grid, with the evolution of the information obtained in the practical research.

- Modification (adaptation or elimination) of factors whose validity is not confirmed or which are misunderstood/ misrepresented.

- Conduct of qualitative and quantitative surveys to explore topics of particular interest.

- Extensive analysis of the results of practical research, regarding the novelty elements and their way of intercalation with the results available in the theoretical research.

- The synthesis of the obtained information and the grouping on categories of factors, in order to facilitate the processing of the large amount of obtained data and for the logical demarcation of the influencing factors' action flows.
- Extraction of logical correlations between the identified influencing factors.
- Compact expression of the way in which the analyzed context (i.e. online education) influences the learning process (i.e. of students).
- Identification of the aspects that require additional study, of the logic gaps, of the limits of the research activities carried out, in order to demarcate the needs for improvement and continuation of the integrated analysis of the learning process.
- Capitalization of the obtained results and indication of the directions for implementation into practice. Substantiation of decisions for calibration of the experience and educational systems.
- Meta-analysis of the ISA integrated analysis framework, in order to identify the limits and continue its development.

4.   ISA Integrated Analysis

Insights on Structure of ISA Integrated Analysis
A thorough analysis on the existing literature revealed a series of correlations between the evolution of the students' learning process in online education and various (internal and external) factors that pose an influence on the dynamics of the process.

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[Naddeo et al., 2021, p.47] proposes the organization of factors influencing the learning process and well-being of students and instructors, in four categories:
i) *Human characteristics* (e.g. physical, mental, personal, lifestyle, expectations);
ii) *Characteristics of the technical tools* used to support the educational process (e.g. positioning and use of the computer, furniture and ergonomics of the space where the activity takes place, teaching materials, electronic devices);
iii) *Characteristics of work tasks* (e.g. procedural development, type of activity, type of equipment used);
iv) *Characteristics of the working environment* (e.g. comfort felt due to the practical quality of the materials, cleanliness and order, visual, acoustic, olfactory aspects).

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[Eom & Ashill, 2016, p.189] proposes a model of systemic analysis of the learning process in an online context, which contains:
i) A series of *process variables*, related to: *the learning process* (cognitive – e.g. perception, attention, cognitive loading, coding, transfer, use and metacognition), *the self-regulation process* (e.g. intrinsic and extrinsic motivation, learning strategies, time management, metacognition, effort management, critical thinking, exercise, elaboration, organization) and *dialogue* (student-student and student-instructor);
ii) A series of *variables complementary to the learning process*, related to: *learning styles* (psychological component), *personality* (affective component), *information processing style* (cognitive component) and *psychological differences* (psychological component);
iii) A series of *input variables*, related to: *students* (motivation, commitment, effort), *instructors* (course design, facilitation, communication, feedback) and *technological systems* used (quality of information, quality of systems);
iv) A series of *output variables*, related to: *learning outcomes* and *student satisfaction*.

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[Gâf-Deac, 2020, p.175-182, 192] mentions the following categories of factors that influence the learning process in an online context:

i) The context in which the student stands (environment, his current situation, different input-reception sensors, interaction with instructors and institutional management conditions for the preparation and organization of the educational process, etc.);

ii) The student's manner and means of communication (in student-instructor and student-student relationship), as well as the quality of the materials used;

iii) The student's intellectual capacity for thinking and memorization, including: the level of development, the potential for the autonomous evolution, as well as the information processing model.

The author also mentions a series of main criteria for the quality evaluation of an education system, apud. [Marga, A. 2000], of which we can mention the following as having specific relevance for the analysis of the learning process in the online educational context:

i) the access and equal opportunities for education and study;

ii) the quality of instructors;

iii) the quality of educational infrastructure;

iv) the resources and resource structure;

v) the mechanisms for quality evaluation and self-evaluation of the training;

vi) the responsibility for the use of available human and material resources;

vii) the scientific competitiveness;

viii) the pragmatic/ practical result obtained;

ix) the renewal/ adaptation/ upgradation availability of the educational system.

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Thus, depending on the *locus of control*, we may classify the factors that influence the learning process in online education as follows:

i) *internal factors*, such as: *personality*, *emotional state* (including psychological aspects of well-being and stress) and *self-regulation* (including initiative, autonomy, openness to IT&C technology, intrinsic motivation, learning style, time management, adaptation);

ii) *external factors*, such as: *interaction with technology* (including time spent in front of the computer, physiological aspects of well-being, quality of devices and Internet connection, surrogate solutions for practice/ laboratory courses, excessive information processing), *communication* (instructor-student and student-student; including learning facilitation, collaboration, support, guidance, as well as the feeling of isolation); *the quality of teaching materials and the organization of the educational process by the university* (including the design and delivery of courses, the quality of technical platforms and institutional programs, available research resources), *actual study* (including the quantity and quality of work tasks, academic stress, learning style) and *the physical context* (the space at home, the environment and the interaction with the roommates, the feeling of isolation).

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In the same time, we may also classify the factors of influence depending on *their quality and mode of action* on the learning process in an online context, as follows:

i) factors with *positive or negative action* (supporting or thwarting the achievement of good learning outcomes, as well as maintaining the students' well-being);

ii) factors with *direct or indirect action* (on the three dimensions of the learning process: management of information, skills and attitudes);

iii) factors with *overall or individual action* (on all or only on part of the three dimensions of the learning process).

As well, the factors can be differentiated depending on *the influence they have on each of the stages of the learning process* (preparation, assimilation, processing, retention, evaluation, use) and *on the specificities of each dimension analyzed* (information, skills, attitudes) thus offering an understanding of the specific needs for modeling, improvement and adaptation of the educational system to the online context.

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The classification of influencing factors into categories supports flexibility, depending on the purpose for which the analysis of the learning process is elaborated. The mindset shown above allows conducting the ISA integrated analysis, while facilitating and encouraging the practical research of a series of hypotheses that need to be tested and validated, for completion of the holistic understanding of the influence of online education on the students' learning process.

Application of ISA Integrated Analysis
ISA integrated analysis conducted on [Eom et al. 2006; Eom & Ashill, 2016; Tello, 2007; Kukreja et al., 2021; Yang & Cornelius, 2004; Paudel, 2021; Kumar, 2021; Liu et al., 2021; Naddeo et al., 2021; Man et al., 2021; Lloyd-Jones, 2021; Minkos & Gelbar, 2020; Co et al., 2021; Dee, 2021; Destino et al., 2021; Flynn et al., 2021; Piyatamrong et al., 2021; Rice et al., 2021] revealed a series of *conclusions* related to the evolution of the students' learning process in online education, such as:

- *Course design*, *preparation* and *inclination towards IT&C technology*, *communication* and *interaction* with the instructor and colleagues, as well as *the quality of the instructor* are factors with a positive influence on all dimensions of students' learning process in the online educational context, if properly adjusted.

- At the same time, *the lack of collaboration* with colleagues negatively affects both the process of acquiring skills and the students' learning attitudes. *The poor quality of course contents* and *the unsatisfactory instructor interaction* negatively affects only the management of learning attitudes.

- *Extrinsic motivation* positively influences the students' management of learning attitudes, satisfaction and well-being. Complementarily, *satisfaction*, *well-being* and *intrinsic motivation* positively influence the students' management of information and skills.

- At the same time, *the lack of intrinsic motivation* negatively affects the whole learning process.

- *Equal opportunities for access to experience* positively influence the process of acquiring knowledge and skills, and *access to teaching materials and programs*, as well as *technical working conditions* (including Internet access), positively influence the whole learning process. *Poor quality or lack alternatives to physical laboratories/ practice courses*, as well as *the lack of physical materials for simulation* affect the process of acquiring practical skills and the management of learning attitudes.

- Moreover, *poor quality or lack of technology and institutional programs* have a negative effect on well-being and the management of learning attitudes.

- *Self-regulation* has a positive influence on the well-being and management of learning attitudes, while *its lack* negatively affects the whole learning process.

- *Time management* positively influences the process of acquiring knowledge and skills, and *flexibility* (conditioned by intrinsic motivation) positively influences the whole learning process (including the management of learning attitudes).

- *Stimulating and supporting initiative and autonomy* have a positive effect on the acquisition of skills.

- *Learning styles* influence the learning process variously:

i) *The visual learning style* has a positive influence on the management of information (which is also dependent on the individual's style of information processing).

ii) *The reading/ writing learning style* positively influences the management of information and skills.

iii) *The auditory learning style* has a positive influence on the information processing if the teaching activities contain instructor-student interaction and facilitation from the instructor, but it can also bring a negative influence, if the teaching experience and the course design are organized mostly visually.

iv) *The kinesthetic learning style* has a positive influence on the acquisition of skills if students have creativity, so as to adapt their techniques and work tools, but can also bring a negative influence, if the implementation of working tasks is (effectively) impossible.

All learning styles, if properly adjusted, managed and adapted to the working conditions and the available tools, have a positive influence on learning attitudes and well-being. However, *auditory* and *kinesthetic learning styles* can negatively affect the attitudinal and mobilizing potential, if the students encounter difficulties in adaptation to the online educational context.

- At the same time, *extroversion* and *feelings of isolation* have negative effects on the management of learning attitudes and well-being.

- Moreover, *the efforts to adapt to online education* and *the academic stress* are factors that negatively influence the management of learning attitudes and well-being, but can be compensated in a positive way by *facilitation of instructor* and *support received in adaptation* to online education.

- *Spontaneous psychological states* can influence the process of acquiring knowledge and skills. At the same time, *personality traits* (such as *open-mindedness*, *agreeableness*, *conscientiousness*) can be assets for positive management of learning attitudes.

- External factors such as *the environmental context*, *the interaction with the family/ roommates*, *the financial situation* can have a positive influence on well-being and management of learning attitudes, while *engaging in extracurricular activities* can have a negative effect on them.

Research Validation

We used the topics mentioned above as a starting point for conducting two sequential studies, aiming to consolidate the ISA integrated analysis on the students' learning process in online education.

The first study [Popescu et al., 2021] analyzed the evolution of the students' well-being in online education in Covid-19 context, by approaching a general perspective on didactic and psychological implications that influenced the students' learning process. As a general conclusion, we found that students experience an emotional imbalance in the fully online education context, mainly due to *the lack of physical social interactions* and *to the overall tiredness* generated by the high workload, while they benefit from *a more autonomous decision making process* that allows them to self-organize the learning process.

As a next step, in [Popescu, 2021] we narrowed our attention on the importance of the students' individual autonomy for the evolution of the learning process, as well as on the dynamics of the acquisition of practical skills in online education. We found that *practice tools, contextual nature of the practical activity, facilitation by instructor* and *individual autonomy* have a high impact on the students' acquisition of practical skills in online education. More so, *individual autonomy* plays a key role for supporting the learning process in online education.

The two studies offered us an extensive understanding on the students' learning process in online education, validating the most part of the research topics identified in the scientific literature (that

are in the previous subchapter), populating the ISA integrated framework with specific insights (as shown in Table 4) and issuing new perspectives of research for some still unanswered questions.

5. Results

The *ISA integrated framework* has been built up as a result of theoretical and practical research, aiming to holistically describe the students' learning process in online education context. The results of the analysis have been inserted graphically in the table below, thus offering a fluent classification of the factors that impact the learning process at all its dimensions (related to the management of information, skills and attitudes).

ISA grid for an integrated analysis of the students' learning process in online education

Management of *Information*:

Preparation	Assimilation	Processing	Retention	Evaluation	Use
Curiosity	Reception and perception	Processing and understanding	Retention	Testing/ evaluation	Capitalization
Direct positive influence					
		Visual learning style			
			Reading/ writing learning style		
Communication and interaction with instructors and colleagues					
Instructor – didactic quality, feedback, facilitation, motivational stimulation, up-to-date training					
Course design					
Intrinsic motivation					
Informational processing style					
Preparation and inclination towards IT&C technology					
Availability of online research					
Access to various and authentic knowledge resources					
Self-regulation					
Indirect positive influence					
Satisfaction					
Auditory learning style (conditioned by interaction and facilitation)					
Flexibility (conditioned by personality and intrinsic motivation)					
Technical working conditions (e.g. Internet access, device quality, university tools)					
Access to global/ multi-cultural community					
Time management					
Psychological anchoring factors (e.g. clothes, posture)					
Equal opportunity for access to information					
Direct negative influence					
Lack of self-regulation					
Lack of intrinsic motivation					
Indirect negative influence					
Auditory learning style (conditioned by the course design)					

Management of *Skills*:

Preparation	Assimilation	Processing	Retention	Evaluation	Use
Mobilization	Primary interaction	Exploration and knowledge	Understanding of logic	Application	Creation
Direct positive influence					
			Reading/ writing learning style		
Communication and interaction with instructors and colleagues					
Instructor – didactic quality, feedback, facilitation, motivational stimulation, up-to-date training					
Course design					
Intrinsic motivation					
Preparation and inclination towards IT&C technology					
Availability of online research					
Access to various and authentic knowledge resources					

Stimulation and support of initiative and autonomy
Software/ cognitive character of the laboratory/ practice courses
Self-regulation
Indirect positive influence
Satisfaction
Kinesthetic learning style (conditioned by adaptation and creativity)
Flexibility (conditioned by personality and intrinsic motivation)
Technical working conditions (e.g. Internet access, device quality, university tools)
Time management
Psychological anchoring factors (e.g. clothes, posture)
Equal opportunity for access to information
Teamwork and collaboration
Direct negative influence
Lack of self-regulation
Lack of intrinsic motivation
Lack of collaboration with colleagues
Low quality or lack of alternatives to physical laboratory/ practice courses (hardware; experiential)
Indirect negative influence
Kinesthetic learning style (conditioned by practical implementation)
Dependence on physical materials for simulation

Management of *Attitudes*:

Preparation	Assimilation	Processing	Retention	Evaluation	Use
Motivation	Openness	Initiative, Will & Action	Awareness	Satisfied emotion	Proactivity
Self-organization, meta-cognition, exercise, effort management					
Direct positive influence					
Learning style					
Communication and interaction with instructors and colleagues (dialogue, facilitation)					
Instructor – didactic quality, feedback, facilitation, motivational stimulation, up-to-date training					
Course design					
Preparation and inclination towards IT&C technology					
Open mindedness, agreeableness, conscientiousness					
Personality and individual psychological differences					
Institutional technology and programs for online education					
Self-regulation					
Indirect positive influence					
Extrinsic motivation					
Flexibility (conditioned by personality and intrinsic motivation)					
Perspectives on return/ capitalization					
Technical working conditions (e.g. Internet access, device quality)					
Instructor facilitation for adaptation to online education					
Environmental context and interaction with family/ roommates					
Introversion					
Direct negative influence					
Low quality of courses contents					
Unsatisfactory interaction with instructor					
Low quality or lack of institutional technology and programs for online education					
Extraversion					
Feelings of isolation					
Lack of self-regulation					
Lack of intrinsic motivation					
Academic stress (overwhelming, confusion, tiredness)					
Lack of collaboration with colleagues					
Low quality or lack of alternatives to physical laboratory/ practice courses (hardware; experiential)					
Indirect negative influence					
Auditory learning style (conditioned by lack of adaptation)					
Kinesthetic learning style (conditioned by lack of adaptation)					
Students engagement in extracurricular activities					

Efforts for adaptation to the online education
Physical health/ discomfort issues

Table 4 – Populated ISA Integrated Grid for the students' learning process in online education

6.   Further Perspectives

Among the subjects of interest that remained open for further exploration, we noticed a series of topics that would bring a more in-depth perspective on our analysis, emerging as follows:

- *The introvert-extrovert character* influence the learning process in the context of online education.
- *The introvert-extrovert character* may correlate with *the learning styles*, thus influencing variously the students' learning process in the context of online education.
- *The style of information processing* directly influences the management of information, thus requiring adjustments for capitalization of the information-centered learning process (which is predominant in the online education context.)
- An analysis on the students' adaptation to long-term exposure to online working conditions may provide valuable psychological and administrative knowledge in support of the decisions to calibrate the educational systems.
- Quantitative research efforts should complement the holistic analysis, in order to confirm and quantify the results, as well as to support precise implementation of the decisions into practice.

7.   Practical Implications

In a General Context:

- **Overview**. A holistic approach is needed to analyze the influence of online education on the learning process, especially in the unprecedented conditions marked by the complete and sudden transition from the physical to the online context, which did not allow a proper adaptation of the educational actors. The accelerated pace of events (which involved quick/ spontaneous decisions on switching from traditional to online education) deprived people of the chance to reflect in detail on the newly arisen educational changes and needs.
- **Management of change and of educational crises**. The novelty elements are represented both by the context of online education and by the process of change/ switching from classical to online education.

Given that the educational system has not yet encountered such a large, sudden and forced change, the transformational process during the pandemic crisis can be seen as a situation of educational crisis that requires proper management, at all levels of decision: from national policies to students (as direct beneficiaries of education).

Insufficient attention to change management can produce undesirable side effects, both in the short term (visible in inadequate adaptation) and in the long term (revealed by a lack of understanding of the calibration needs for individual, institutional and systemic educational decisions).

- **Phenomenological approach**. It is necessary to pay extensive attention to the analyzed phenomenon, as online education has affected both the didactic and personal existence plans, for all the educational actors involved. The changes produced are both at the level of appearance and essence, reaching the entire structure of the educational process.
- **Substantiation of decisions**. Adequate analysis on the evolution of the educational process in a complete online context (and following a *sudden change* from classical to complete online education) is highly complex and cannot be done without the rigor of scientific research, which

requires a long time range. But the ability to quickly extract valid basic/ essential information for describing the phenomenon, brings opportunity and facilitation for the adaptation of all parties involved in the educational process, being not only necessary but also indispensable for substantiating decisions.

- **Visible, but insufficient adaptation**. Both students and instructors, as well as auxiliary and management staff, made consistent efforts to adapt, in the first three semesters of online education (conducted in between 2020-2021). One year since the pandemic, there are nuances of calibration and efforts of adjustment for the educational process, but they are still insufficient. Institutional and systemic adaptation decisions require integrated and concentrated efforts, with direct implementation, rapid engagement and continuous monitoring (to allow for their traceability and adaptation, as educational activities evolve).

- **Warning, lessons learned and anticipatory training**. Looking backwards, more efforts should have been made in the summer of 2020, to analyze and manage the educational crisis risks, as well as to develop response scenarios and effective solutions for educational policies, university institutions and instructors. But the uncertainty and confusion that hovered at that time helped maintaining some gaps in adaptation, which have been directly reflected in the learning process and in the well-being of students in the 2020-2021 academic year.

At the beginning of the 2021 summer, regardless of the forecast for the evolution of the pandemic crisis – which would lead to the establishment of the classical or online context for the 2021-2022 academic year – the situation requires all educational actors to seriously reflect on the need to improve educational conditions, so as to maximize the potential of capitalization on any context (classical, online or mixed) in which they will evolve.

Regarding the Students:

- **Knowing and facilitating the manifestation of students' preferences**. Students develop a form of expression autonomy and selectivity, tending to make the most favorable decisions from their own perspective. Efficiency can be achieved in the educational process by providing students with appropriate working conditions and materials that allow them decision-making flexibility and freedom of expression.

This desideratum implies the allocation of sufficient resources and, possibly, even in excess, in relation to the existent needs, so as to allow redundancy in choices and the readiness for switching between alternatives (in order to choose the optimal option). Similarly, educational policies should allow decision-making flexibility at the local level, to make the most efficient use of available resources and to allow the acquisition of the most diverse and extensive managerial knowledge (in relation to the context of the pandemic crisis).

- **Knowing the experience of the education beneficiaries**. On the background of emotional instability (generated by the pandemic crisis), the solutions chosen by the students bring a greater efficiency to the learning process than the top-down imposed ones (which are not synchronized with their will). Students should be consulted about the user experience, so that management and educational decisions gain the highest possible rate of acceptance and assimilation.

- **Marketing for attention catching**. The online and/or mixed educational context must have advanced forms of presentation and appearance (through marketing and content organization), so as to become competitive with other sources of information and media channels accessible to students. These aspects require both a proper capitalization of institutional resources and the corresponding training of instructors, in areas of personal development collateral to their specialization and to the instructor profile.

- **Management of large amounts of information**. In the current context of life, marked by a frequent use of digital technology, students face a constant need to manage large amounts of information. Extracting the essence and understanding the meaning (both within and outside the learning process) become permanent goals that require students' attention and consistent effort. Managing large amounts of information changes the pace of work and the mental dynamics, generating new needs for human adaptation.

- **Interactivity**. The conduct of online teaching courses must involve efficient mechanisms/ techniques of presentation (e.g. techniques of public communication, debating) that stimulate students' interest and support their creativity of expression, in order to maintain them engaged during the courses.

- **Instructor support** is a key element for students' engagement and for monitoring their evolution in times of educational crisis that require an online educational context. Although students' need for didactic and emotional support depends on several factors (internal – such as the degree of autonomy, the predisposition to introversion/ extraversion; and external – such as the involvement in collective activities, the degree of socialization, the domestic context and the social interactions), the instructor plays a vital role in maintaining the students' engagement and in directing them throughout the educational process.

- **Students' experiential involvement**. Students need to understand the meaning/ purpose of the courses they attend, to identify their importance and relevance for the personal life context, so that their autonomy to be stimulated and their openness towards team collaboration to be encouraged. Involvement in group activities and in direct work with instructors, for the development of meaningful content, can compensate for the lack of physical presence/ direct social contact and improve the emotional state.

- **Avoiding monotony**. Generally, students have a more selfish attitude towards passing the challenges of this period (of online education), being focused on maintenance of a satisfactory level of well-being. Often, students are satisfied with a number of limitations brought by the online education, perceiving them as an external factor that justifies any compromise or negligent learning attitude. Autonomy and individual awareness are vital for students to maintain a high level of academic performance during this period of online education.

- **Self-regulation and resource management**. Online education has led students to analyze and reflect on their availability to manage the (inner and outer) resources. The interruption of the rhythm of classical education, the increase of available personal time and the decrease of the time for social interaction and for shifting between various physical locations, these all brought to students the freedom to manage their own time and resources. The responsibility of self-organization entails the need for self-awareness, to allow a proper understanding and guiding of the daily/ routine decisions.

In return, instructor imposed an increased amount of regular homework, which unexpectedly filled students' time and freedom of expression, generating excessive pressure and chronic fatigue.

The need for efficient management of the new personal context (marked by oversaturation with work tasks and by a lack of knowledge regarding the own biorhythm management) required the students to turn their attention inwards and to make additional efforts for calibration and adaptation.

- **Students' self-awareness** (which includes: knowing and understanding one's own personality profile; awareness, mastery and improvement of learning style; proper understanding, acceptance and capitalization of predispositions towards introversion/ extraversion; understanding and control of emotional predispositions, states and feelings) is an asset that can exploited to maintain an appropriate state of well-being and to create optimal learning conditions for oneself, in the context of online education.

- **Direct/ natural adaptation of students to the living conditions**. Students take profit from the side benefits identified in online education (especially those related to the use and capitalization of digital technology, as well as those related to the freedom of own resources management) and are optimistic that they can use them for the own good. The better the educational conditions the institutions offer, the more the students capitalize on them to a greater extent.

Regarding the Instructors:

- **Support for instructors**, from institutions. Instructors feel a level of stress beyond the desirable healthy thresholds, as they have the implicit responsibility to calibrate and adapt didactic methods, techniques and tools to best meet the needs of students. However, the actual results are not always effective (and especially appreciated), thus generating feelings of frustration, helplessness and exhaustion among instructors.

- **Anticipatory preparation for the educational crisis management**. Alternative training can give instructors an impetus for personal development, for an interactive and humanistic didactic approach, as well as for adaptation to special situations.

Trainings such as: coaching in education (individually and collectively), specialty counseling, knowledge management (which includes the management, presentation and proper processing of information), talent management and development, change management, psychological counseling, etc. they all can bring considerable added value to instructors in sustaining the educational process both in periods of normal evolution and in situations of crisis.

Although all these elements of collateral knowledge may be perceived as burdensome (or unnecessary) by the beneficiaries, they become increasingly important in times of educational crisis, for supporting the crossing of difficult times (by both instructors and students).

- **Adjustment of administrative bureaucracy**. The transition from classical to online education has put considerable additional pressure on instructors, forcing them not only to adapt (as individuals) to change, but also to think and implement decisions to calibrate the educational process, to support students, to provide feedback to higher decisional levels and to go through a whole series of new bureaucratic activities that have either been transposed punctually from the classical didactic and administrative experience, or have been created additionally out of a need to compensate for the lack the classical educational context.

As any other digital transformation process, online education has created a ballast of activities that overwhelm instructors, depriving them of the freedom to filter the administrative obligations according to their implementation needs. The cumulation of previously held administrative and didactic tasks (in classical education) with new ones (occasioned by online education) creates the risk of physical and mental unavailability of instructors. In order to avoid this psychic pressure, it is necessary to cleanse/ sanitize the administrative and didactic responsibilities, to keep only what is proven useful. Questioning and reforming organizational procedures should generate simplicity and flexibility in collateral activities (i.e. preparation and support for the educational process), giving instructors the opportunity to show a high performance in teaching activities.

Regarding the Educational Institutions:

- **Modernization of work**. Instructors and institutions need to make consistent efforts to process work materials, to adapt delivery approaches and to mix the traditional and modern educational methods (including current platforms that go beyond the education domain, e.g. social media, Internet, mobile applications), in order to maintain a high level of curiosity, involvement, participation and autonomous engagement of students in the learning process.

• **Interspersing of life contexts**. Online activities have predisposed educational actors to mix and intersperse life contexts, thus minimizing or even eliminating the boundaries between them.

In the classical/ physical context, people had sufficient time to switch between activities, as a direct consequence of administrative procedures (e.g. that imposed breaks between courses) or as a side effect of physical shifting between locations, allowing them to assimilate the experiences and to process the information.

The lack of these intermediate time intervals caused the activities to intertwine, thus burdening the proper assimilation of contents and generating a form of mental saturation and physical fatigue. In the context of complete online education, time management and careful separation of activities (that would allow transitions for experiential assimilation, as well as for informational, meta-cognitive and reflective management) are necessary (if not imperative) to maintain a proper behavioral and psychological hygiene.

At the same time, it is also important to define adapted and fluent institutional procedures regarding the management of educational activities in an online context, as well as to define specific rules of conduct and behavior in the support of online interactions.

• **Online transposition by adaptation, not by transcription**. The transposition of the didactic and administrative activities from the classical/ physical context into the online one must be done in an adapted way, according to the existing needs in the virtual (online) space, and not by taking them in the exact form that resides in the physical environment. The digital transformation involves adaptation and calibration of the processes, in order to reach the highest possible efficiency and the elimination of the ballast (bureaucratic, procedural, customary, dependent on the physical environment conditioning).

Understanding the characteristics of the virtual environment (e.g. flexibility in implementation, scalability and multiplication, parallel processing, multimedia diversity) allows and facilitates its proper use and exploitation.

• **Adapted practice/ laboratory context**. Education policy makers and universities must urgently identify ways to compensate for the lack of physical context of practice, for situations where it is indispensable (see [Popescu, 2021]). Practice activities dependent on physical space, tools and interaction require creative solutions and considerable effort to be transposed and developed in the context of online education, so as to ensure a satisfactory rate of acquisition of practical skills, in accordance with the classical education rigors and labor market needs.

• **Quick institutional adaptation**. Academic institutions need an in-depth analysis, to adapt to online educational context, taking full advantage of the experience gained so far. In case the online education continues to remain a requirement in the coming years, academic institutions must consider the official switching to a blended learning system, that would ensure proper long-term educational conditions.

Beyond the reasons for ensuring the corresponding functioning of the educational context (which is a passive/ reactive/ compulsory/ externally imposed need), implementation of high quality online and/or mixed education is justified and imposed also for leveraging and capitalization of the opportunities that reside in the (current and future) social and technological environment (which represents a need for proactive/ voluntary/ conscious/ entrepreneurial development).

8. Discussions

Factors of influence can bring both positive and negative effects on the learning process in the online educational context, acting as a series of triggers and shapers of students' experiences. The diversity of the conditions for the manifestation of the influencing factors can generate a variety of

types of answers whose analysis can be performed either in uni-factorial or in complex/ correlated/ multi-factorial approaches.

In addition, these factors may influence only the level of certain learning stages, as well as only some of the dimensions of the learning process (e.g. visual learning style brings a positive impact in the stages of assimilation, processing and retention of information), thus leaving room for a broad spectrum of possibilities for analysis on the students' learning process in online education.

In-depth studies on the topic are needed in order to extract the best image on the evolution of the students' learning process. The more refined the conclusions of the discoveries, the better the documentation for the decisions of adaptation of the future educational systems.

ISA integrated analysis revealed the potential to holistically approach and understand the dynamics of the students' learning process in online education, setting a proper framework for correlative inter-factorial deductions and offering an eloquent and facile way for a compact showcase of the phenomenon. It also offers the possibility to adjust the level of detail in which the analysis is conducted, by classifying and refining the specificities of the concerned factors of influence, thus allowing particular calibrations to the needs of the research interests.

Benefits of ISA Framework

- The main benefit of the ISA integrated analysis framework is that it offers *the possibility to organize and conduct analyzes on large amounts of information*, concerning the entire learning process. It allows to achieve a logical overview on the factors that influence the learning process, which can be easily capitalized and used for practical purposes (e.g. for calibrating decisions to improve experiences and educational systems).

- We also mention *the flexibility* of the framework to accommodate the analysis on the learning process for any age category of students, as well as *to adapt/ extrapolate/ apply* it according to different contexts of interest (e.g. in online education, in mixed/ blended learning format, in classical education, etc.). For this paper, the analysis of the learning process is carried out for students (from undergraduate and master's degree cycles), in the particular context of complete online education (generated by the pandemic crisis in between 2020-2021).

- Additionally, *the framework can be developed in multi-dimensional format*, depending on the types of categories for the analyzed factors. In the current form of the ISA integrated analysis grid, the factors are grouped according to the type of influence (positive and negative, direct and indirect) brought at the level of each dimension and stage of the learning process.

- Adding categories for the classification of influencing factors would complicate the form of this kind of two-dimensional representation, thus requiring the imagination of a multi-dimensional form that organizes and reflects as eloquently as possible all the contents of interest. *The ease of reading and scrolling* through such a grid depends on the developer's ability for graphical representation.

Limitations of ISA Framework

- In its current form, the framework does not visually represent the correlations (dynamics) between the analyzed influencing factors. It does not express quantitatively or procedurally their mode of action. To compensate for these shortcomings, it would be necessary to introduce additional visual elements, which could create the risk of complicating the easy scrolling of the contents.

- In the same note, the grid reveals an organization focused on the learning process, limiting the analysis only from the perspective of the influences brought to its stages and dimensions. The

cumulative (individualized) evaluation of a certain factor at the level of the whole learning process requires secondary actions of analysis and information processing.

- In addition, the current grid structure separates the dimensions of the learning process, making it difficult to express (visually) the interdependencies between them. For further development, the framework should take into account the common inter-dimensional elements (e.g. information processing exists both in the *information management dimension* and in the *process of acquiring practical skills*) and insert tracking mechanisms for the correlations and the dynamics at the level of the whole learning process.

- The framework presents only statically the evolution of the learning process, by reference to its stages and dimensions. A possible analysis of the cumulative influence of a certain factor on the whole learning process requires additional information processing operations. To eliminate this shortcoming, the framework could be implemented in electronic format, in the form of databases, so as to facilitate the organization of information also depending on the influencing factors inserted in the grid.

- Most of the factors did not receive a description on the influence generated at each stage of the learning process. This differentiation can be achieved by carrying out quantitative practical research, which should conclusively and punctually evoke the dynamics of the learning process.

- The integrated analysis of the learning process requires considerable efforts, to achieve a precise image of the influencing factors. Although it provided a holistic understanding of the phenomenon, this paper does not have quantitative research data to support the validation and quantification of the processes described.

- ISA integrated analysis requires the maintenance of a long-term observation on the analyzed subjects (preferably even after graduation and their integration into the workplace) in order to generate knowledge about the retention and quality of skills acquired in the context of online education, compared to the similar evolution of previous generations of students, trained in classical education.

9.   Conclusions

Online education has created the premises for major changes in the learning process, due to substantial modifications in the context of educational activities. Aspects such as *social and didactic interaction*, *autonomy* (including self-regulation, self-organization, self-motivation), *emotional and motivational dynamics*, *personality expression*, *didactic context* were directly influenced by the contextual changes in which educational activities took place, thus generating diverse repercussions on students.

The learning process in the context of classical education is a subject approached both in detail (niched, branched, elaborated) and as a whole, thanks to the maturity that the field of Education Sciences has acquired over time. But the sudden and complete change of the context (from the classical to the online one) forces academic decision makers to manage some novelties with complex and unknown consequences. Understanding the repercussions of online education (through its sudden and complete installation) is vital for substantiating decisions to adapt educational activities and systems, so that students can benefit from an increased level of educational quality that would facilitate the maintenance of a high academic performance.

The ISA integrated analysis framework is an effective tool that facilitates the management of large amounts of data related to the evolution of the students' learning process in the online education. The results obtained in this paper can be used to quickly substantiate decisions to adapt education systems, while providing consistent knowledge for further analysis and recalibration (that would lead to medium and long-term adaptations).

Acknowledgements

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