E-learning Indicators to Improve the Effectiveness of the Learning Process

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Abstract—The online services are becoming a fundamental component of the educational system even configuring a new structure for it of which ICT (Information and Communication Technology) is, so to speak, its backbone, thus influencing didactics as well. Thousands of projects of e-learning having different results have been realized in recent years: there isn’t, in fact, any standard way to plan the project and evaluate its results and its effectiveness. The main objective of this article concerns a study of the potential approaches for the planning, development and evaluation of an e-learning project. The output of this study is represented by a system of indicators for the evaluation of the quality of e-learning. The methodology proposed, of the e-learning indicators, is an empirical methodology that produces concrete results expressed in numbers, that may be analysed and used at a later stage in order to check the effectiveness of the e-learning project.

Index Terms—e-learning indicators, evaluation of effectiveness, strategies.

I. INTRODUCTION

The implementation of new “global communication” systems and of new learning platforms demands from the educational institutions for a “rewriting” of the paradigms lying at the heart of the educational processes. The “rewriting” has not occurred yet, but in the meanwhile many schools are trying to apply the new communication systems ("Information and Communications Technology") and offer, besides the traditional services, actual online services.

And it is within this very new context that the virtual learning environment might become a tool of and for didactics [1] by virtue of:

- the attention to the actors involved;
- crucial changes of the teacher role (teachers must acquire or develop new skills and abilities in order to become designers of learning materials);
- a cross-disciplinary approach;
- a thoughtful consideration for the integration of the socio-cultural elements;
- greater accessibility and flexibility of space and time to the virtual learning environments.

One of the effects that ICT produced was the transition from the model marked by the relationship same classroom-class to a new model that leverages the various didactic layouts which may be created by a different dosage of the classroom and of the class with the new ingredients that didactics inherits from the network technologies [2]. It is a transition that is well rendered by the image of a Brick School (only walls and buildings) giving way to the Brick-and-Click School [2] (here click obviously stands for the keyboard, ergo the computer).

In this new context the central role is played by the operations of monitoring and analysis. Without them the online environment will barely be able to emancipate from a perception that envisages it only in ancillary terms with respect to the education system and not, as it should be, as an element integrated into it and, actually, able to guarantee added value to it [2]: the monitoring and analysis of the learning processes assume an indispensable role for the development of quality processes.

The study presented in this article is based on a pilot project, "Digital School", which used an (temporary) online platform open to students and teachers of various disciplines. The main objective was to improve the quality of the learning process by providing access to resources, services, collaboration and interchanges. The entire process (which lasted for about 6 months) saw teachers and students of secondary schools, upper schools and universities get involved. A series of (e-learning) indicators, useful to the analysis and evaluation of a learning process, was drafted by analysing the results of a series of questionnaires proposed to the students (ex-ante, in-itinere and ex-post), in addition to the analysis of the data derived directly from the use of the platform (see paragraph 4) and of the evaluations on learning (proposed by the teachers to the students: the idea was to find a standard way to plan an e-learning project in general, but also for the evaluation of its results and of its effectiveness.

II. EVALUATION

When the school introduces ICT into didactics, there emerges the necessity to deal with the levels of computer literacy of both teachers and students.

A second issue is the necessity to ponder on the relationship that the technologies have with didactics so as to monitor both the changes (or lack thereof) in teachers’ teaching practices and the learning habits and styles of the students.

Finally, we must ask ourselves what advantages does the introduction of the didactic technologies into the teaching activity generate for the teachers and if it allows recording an average performance improvement.

All three questions bring to the center of attention the strategic importance of the evaluation.

First of all the evaluation must be understood as "a specific research activity that by means of collecting, analysing and interpreting data acquired from the most various aspects of a training program, assesses the effectiveness, the efficiency and the quality of a didactic
operation and checks its coherence with the didactic objectives and the ambient conditions under which the training is performed"[4].

The evaluation must be systematic, i.e. such as not to isolate the evaluating activity from the training process [3].

Finally, it is important to assume, with respect to the evaluation (most of all of the learning processes) a standpoint focused on the process more than on the product so as to shift the attention from measuring the student's performance to checking how the teaching process succeeds in staying consistent with the objectives it had targeted [5].

The evaluation in traditional education is added value, but in the case of e-learning processes, it becomes a necessity.

(Feed-back) The evaluation is an important monitoring device of the teaching/learning process [6]: for the teacher, who thanks to it can better guide his own action, redesign it while it is in progress, check the effectiveness of its didactics; for the student, who, in turn, may comprehend, in real time, the status of his learning, his difficulties, the type of work he must do.

Motivation is also a function to attribute mostly to the problem of lack of physical presence in the online work, in particular, to the perception of the student of being isolated in relation to his colleagues [7]; a perception that may encourage the slow distancing of the student from the didactic activities until such distancing really occurs. The evaluation, from this perspective, facilitates the anchoring to the course of the subjects, motivating them and counterbalancing the centrifugal thrust of solitary work[2].

To define the evaluation not as much of the students' learning process, but rather of the way in which the course is designed, realized and managed, we deal with meta-evaluation [2], making it clear that the specific evaluation action is not “internal” to the training activity (as when the student's performance is assessed), but “external”, with respect to the various components of the course (general educational structure, creation of materials, interaction management and so on); alternatively, a process evaluation [2] may be considered, referring to the fact that what is being evaluated are not individual behaviors but the entire course unit with respect to both its dynamic and static components; finally, quality evaluation [2] may be used, hinting at a monitoring logic that one must assume in e-learning in order to control on the appropriateness of the whole education process (structure, preparation, management) relying to different logics (user satisfaction, return on investment, offer optimization) [2].

III. E-LEARNING QUALITY INDICATORS

If the objective of the "Digital School" was to induce substantial learning in students, its effectiveness would have been all the greater the more the "Digital School" produced a higher number of students to reach the preset objectives in terms of knowledge, ability and meta-quality.

To evaluate the skills acquired by the students is, therefore, an indirect way of assessing the effectiveness of the course. This evaluation is, however, an ex-post evaluation (see paragraph 5).

In-depth knowledge of the skills and motivations a student adheres to in a course (e-learning) is a central element for the success of the educational action.

The quality of the course (pertaining to a specific discipline) is certainly higher if it entails monitoring these elements and potential remedial courses so as to bridge the most important deficiencies [8].

Quality indicators on this sub-dimension are [9]:

- the survey of the basic competences: appropriate entrance tests should be used to check whether the users possess the prerequisites and basic competences needed to take on the didactic track, both on the specific competences side (pertaining to a discipline) and on the side of competences related to the technological tools used for the course.
- the survey of the cross competences: within the education track there should be tools and activities to monitor the abilities of interaction and communication supported by technological means, of the abilities to adapt to the didactic models used in the course, of the abilities to interact with the colleagues and to work in a group and take action in case any deficiency occurs.
- the survey of the motivations: a questionnaire should be submitted at the beginning of the course in order to reveal the motivations of the student to attend the course, motivations that may be related to study, to career or to self-realization.

Insofar as the quality of the lesson content is concerned we may consider the following indicators [9]:

- quality of the didactic materials: the materials are complete and easily comprehensible, they are well organized internally, they are rich in examples, preferably drawn from the real world and not invented on purpose and they present the problem from several perspectives; the materials are updated;
- appropriateness of the lesson content: the content corresponds to what is listed in the program, it reflects the expectations of the students, it is proportioned to their capacity and congruent with the prerequisites defined for the admission to the course;
- possibilities to adapt the program of the course based on the requirements of the attendees: the programs have non rigid articulations so as to be able to change based on the requirements of the attendees and are flexible enough to accept and integrate potential proposals of in-depth analysis of specific themes.

The attendance rate of a student to the activities of a course is directly proportional to the interest aroused in him by the themes dealt with in the course and in the activities performed [9] [10].

The following are indicators of the attendance level:

- number and relevance of the interventions for every single attendee;
- the number of network accesses aiming at downloading material needed for the in-depth analysis of the themes being studied, for every single attendee;
• the number of messages sent by every single attendee to another student; the number of messages sent by every single attendee to the.

What we mean by “students' results” is not the mere pass of a final examination with a more or less high pass mark but the achievement by the students of certain training goals, that can be distinguished as initial, intermediate and final [9].

The indicators in this case may be:

• **goal achievement indicators**, i.e. indicators that express whether the attendees reached, in their final tests, results considered satisfactory by themselves and the teacher, whether they reached the goals set at the beginning of the course (initial, intermediate and final), whether they consider they have acquired all the knowledge and abilities they aimed for when they enrolled in the course.

• **indicators based on the success/dropout rates**, i.e. the number of students that finish the course over the number of students enrolled (success rate), the number of students who drop out over the number of students enrolled (dropout rate).

As far as the quality of the didactic process is concerned, it can be divided into two sections.

The first is the quality of the didactic support, indicated by the activities of the tutor in terms of: socialization, stimulus, assistance, response, explanation, chairing, planning, evaluation, presence, availability.

The second section deals with the perception the students have on the evolution of their own competences during the course.

The indicators of this dimension are:

the learning results in a proper sense, i.e. the students' perception of their own acquisition of knowledge and abilities;

the non-learning results, i.e. the students' perception of their own personal growth, of the development of the sense of self-efficacy, self-esteem and motivation.

Also to be considered, the quality of the interaction between the tutor and the attendees: it is a model of interaction between individuals placed on different cognitive levels. The quality of this interaction is defined by the following indicators:

• the number of interventions of the tutor;

• the frequency of the information exchange between the tutor and the attendees;

• the capacity of the tutor to create a friendly environment;

• the tutor's availability and presence;

• his capacity to provide punctual responses to the issues of the students and their in-depth analysis requests;

• the efficacy of his interventions.

Finally, we must also take into consideration the quality of the interaction among the students (peer-to-peer interaction). This is defined by the following indicators:

• number of (relevant) interventions of a course participant;

• availability of the attendees towards the other attendees;

• the productivity of the exchanges;

• creation of a favorable ambient in class.

IV. MONITORING AND EVALUATION

The evaluation is defined by Hadji [11] as the formulation of a value judgement on a given reality, i.e. an assignment of meaning to facts, data and information. The evaluation process is based therefore on the identification and selection of a certain quality level to tend towards and on the basis of which to compare oneself in order to formulate one's own judgement [10] [11] [12].

Focusing its attention on the “Digital school” and therefore on its purpose (improve the quality of learning through access to resources, services and collaborations and exchanges) the monitoring and evaluation of the learning processes assumed an indispensable role in the development of quality processes.

Monitoring and evaluation are two concepts that are often confused with one another: monitoring is an information activity, characterized by regular surveys, that give an idea of the flow and of the continuity while the evaluation is not performed all through the process, but only in certain moments and it involves the formulation of a judgment [13].

The operations of monitoring and evaluation are meant to check whether the activities and the tools used in the field generate the expected results compared to the preset objectives.

V. THE SURVEY

The stages of monitoring and evaluation may be performed by using different tools. The most important among them is the survey.

The ex ante survey

The ex ante survey occurs before the beginning of the activities and is configured as a moment of “support to the decision” [14]: analysis of strong and weak points, on the potentialities and the risks of a certain type of intervention.

The ex-ante ex ante evaluation that analyses the initial needs and feasibility of the planned programs should avail itself of the in-itinere (in-progress) and ex post evaluations of the preceding planning cycle.

The in-itinere survey

This moment of the evaluation is meant to check whether the actions are performed in accordance with the preset objectives, in terms of didactics and organization, in order to plan potential in-progress interventions. The process being developed in an online course is always characterized by specific strategies of didactic mediation [15], i.e. it develops, on the basis of modalities defined at the planning stage and possibly remodelled in progress, specific mediation processes between the student and the
new pieces of knowledge, facilitating the construction of new knowledge and new competences; this mediation is developed (in different forms and to different extents) by the didactic materials, by the teachers, by the tutors and by the learning community [16].

The in-itinere evaluation should refer to the data of the monitoring system but also to the ex ante evaluation and the ex post evaluation (of a previous course), the conclusions of which might be used as a reference point.

The ex post survey

The conclusion of a program is the stage at which an effect, a result should be reached [16]. The ex-post evaluation checks whether a program has produced results, trying to estimate their value, their characteristics.

The ex-post evaluation, which analyses how the objectives were reached, should refer to the ex-ante and in-itinere stages, to the extent to which it identifies the corrections to be made in the program.

The three evaluation stages (ex-ante, itinere and ex-post) should however be integrated if one wants to complete the work of conceiving the evaluation as learning: to learn, that is, from the experience of the past so as to suggest.

VI. PERFORMANCE INDICATORS

This section presents the results of the analysis performed on the “Digital School” project. It is a series of derivatives from a series of (ex-ante, in itinere and ex-post) surveys diversified on the basis of the education level of the student it was meant for (secondary school, upper school or university), from the evaluations of the various learning checks assigned by the teachers to the students and from the (numerical) data deriving from the use of the platform.

These indicators were divided in turn on the basis of different aspects and elements that characterize an e-learning course: this way it is easier to highlight the fortes against the weaknesses, the opportunities against the threats.

Utilization of the human resources of the institute

<table>
<thead>
<tr>
<th>Objective</th>
<th>Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiation of a training course on a particular theme to meet the educational requirements of most of the teachers</td>
<td>Percentage of teachers who participate in the initiated course</td>
</tr>
<tr>
<td></td>
<td>Levels of satisfaction of teachers with respect to the initiated course</td>
</tr>
<tr>
<td>Utilization of the teaching staff</td>
<td>Perception of utilization of own work by the teaching staff</td>
</tr>
<tr>
<td></td>
<td>Increase of workplace motivation in own school</td>
</tr>
<tr>
<td></td>
<td>Correspondence between the competences of the teaching staff and the assigned positions</td>
</tr>
</tbody>
</table>

Promotion of the quality of the education processes

<table>
<thead>
<tr>
<th>Objective</th>
<th>Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase of school success</td>
<td>Decrease of students' educational deficits</td>
</tr>
<tr>
<td></td>
<td>Decrease of the number of dropout students</td>
</tr>
<tr>
<td>Promotion of students' psychological and social welfare</td>
<td>Improvement of the teacher-student relationship</td>
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<tr>
<td></td>
<td>Improvement of the relationships among students</td>
</tr>
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<td></td>
<td>Increase of students' self-esteem</td>
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<tr>
<td>Initiation of didactic seminars for the integration of the differently abled students</td>
<td>Percentage of differently able students who participate in the activities together with the others</td>
</tr>
<tr>
<td>Initiation of didactic seminars for the integration of the foreign students</td>
<td>Percentage of foreign students who attend the courses</td>
</tr>
<tr>
<td>Increase of the cross-curricular and meta-cognitive capabilities of the students</td>
<td>Improvement of the organizational competence in the study of students</td>
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<td></td>
<td>Improvement of the capacity to select information during study</td>
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<tr>
<td></td>
<td>Improve the capacity to connect different topics and disciplines</td>
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<tr>
<td></td>
<td>Improvement of the capacity to critically approach study</td>
</tr>
<tr>
<td></td>
<td>Improvement of the capacity to deal with problems during study</td>
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<tr>
<td></td>
<td>Improvement of students' self-assessment capacity</td>
</tr>
<tr>
<td>Increased use of laboratory activities in didactics</td>
<td>Increase of a certain percentage (of the total hours of didactics) of the hours dedicated to laboratory didactics</td>
</tr>
<tr>
<td>Construction of an EPP (Educational Plan Proposal) model shared by teachers, students, parents</td>
<td>Percentage of teachers, parents, students and staff involved in the elaboration of the EPP</td>
</tr>
<tr>
<td></td>
<td>Presence/Absence of public events promoting reflection on the content of the EPP</td>
</tr>
<tr>
<td>Increase the use of IT and multimedia tools in the study of the different school disciplines</td>
<td>Percentage of teachers who use the IT laboratory for didactics</td>
</tr>
<tr>
<td></td>
<td>Percentage of students who declare they have used the computer during the school year in order to study for different disciplines</td>
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</table>

Organization and management of financial resources

<table>
<thead>
<tr>
<th>Objective</th>
<th>Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition of financial resources</td>
<td>Increase of acquired external financial resources</td>
</tr>
<tr>
<td></td>
<td>Number of requested/obtained loans</td>
</tr>
<tr>
<td>Management of financial resources</td>
<td>Low variance between expenses forecast and the real expenses of the project</td>
</tr>
</tbody>
</table>
External relationships, collaborations with the cultural and professional, social and economic resources of the territory.

<table>
<thead>
<tr>
<th>Objective</th>
<th>Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creation of a network with the other schools in the territory</td>
<td>Number of institutes participating in the “Digital School”</td>
</tr>
<tr>
<td></td>
<td>Number of projects realized with the institutes participating in the “Digital School”</td>
</tr>
<tr>
<td>Improve the image of the school</td>
<td>Improvement of the image of the school among key informants in the territory</td>
</tr>
<tr>
<td></td>
<td>Number of people enrolled</td>
</tr>
<tr>
<td></td>
<td>Number of visitors of the website</td>
</tr>
<tr>
<td></td>
<td>Improvement of students’ and parents’ perception of the school</td>
</tr>
<tr>
<td></td>
<td>Number of participants in the events promoted by the school</td>
</tr>
</tbody>
</table>

In an e-Learning course new systems of learning evaluation are born because the classroom context where the education occurs is changed.

**Learning as a social process**

The student moves within a social space: the success of the educational act derives from the active participation of all the individuals involved in the education intervention, from the continuous interaction in the group, from the co-planning of tracks, experience exchanges, from sharing objectives and processes.

**INDICATORS:**

- Intensity of the cooperation among the members
- Creation of a shared repertoire of standards, methods and best practices
- Quantity of common activities realized in order to learn together
- Development of new key competences
- Reduction of the number of complaints from the user
- Capacity to retain the users
- Activity sharing approach

**Learning as an active and intentional process**

The student must be open to a plurality of operational strategies: moving inside the LMS platform he may explore knowledge, experiment notions through virtual laboratories, experience with other students in synchronous and asynchronous mode, being able to build knowledge by means of connections between different sciences.

The student is not only a spectator but also a maker of his own knowledge: he gets used to asking questions and looking for the answers, assuming an active explorer role rather than a passive knowledge researcher role.

**INDICATORS:**

- Creation of a shared repertoire of standards, methods and best practices
- Greater quantitative level of papers and processes
- Development of new key competences
- Reduction of the number of complaints from the user
- Capacity to retain the users

**Learning as a constructive process**

In the online course a framework is developed within which construction and reconstruction of concepts that may become public and collective compositions occurs uninterruptedly. Knowledge develops thanks to the materials made available by the teacher and to the materials that students find online and re-elaborate: this is a stimulus to the establishment of significant learning.

**INDICATORS:**

- Reduction of the times needed to find the adequate solutions
- Greater quantitative level of papers and processes
- Number of ideas and new products
- Quantity of compositions realized
- Quantity of the compositions and of the resources realized together
- Increase of the capacity to use again the knowledge resources

**Learning as a non linear process**

Unlike the traditional classroom (face-to-face) lesson, the online course mirrors a reticulate structure, i.e. the activity is performed by means of concept nodes: that is to say there is a plurality of tracks and alternatives.

**INDICATORS:**

- Creation of a shared repertoire of standards, methods and best practices
- Reduction of the error risk
- Capacity to use resources optimally

**Learning as a self-reflexive process**

An immediate consequence of the above: sailing the knowledge ocean available online requires a summarization of the situation and, if necessary, making adjustments to the track.

The student therefore must be promptly informed with respect to the goals that he must reach: detailed and not vague objectives. The student, initially guided (by the teacher, the tutor or others) will have to progressively acquire meta-cognitive abilities of self-monitoring and self-reflection related to his own learning process.

**INDICATORS:**

- Reduction of the error risk
- Functionality Increase
- User satisfaction degree
- Reduction of the number of complaints from the user

..
Based on what has been said so far we could summarize the indicators as per table 1.

| Indicators referred to the | Speeding up problem solving Basis for cooperative learning Creation of a shared repertoire of standards and resources Reduction of the times needed to find adequate solutions Basis for error correction Higher quality of output and processes Capacity to use resources optimally Effectiveness Increase |
|---------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|
| internal process          |                                                               |                                                               |                                                               |                                                               |                                                               |                                                               |                                                               |
| Indicators referred to the | Number of ideas and new products realized Number of common activities realized together Quality of the output and of the resources realized together Development of new key competences Increase of capacity to use again resources and knowledge |
| learning and growth process|                                                               |                                                               |                                                               |                                                               |                                                               |                                                               |                                                               |
| Indicators referred to the | User satisfaction degree Reduction of the number of complaints from the user Capacity to retain the user Activity sharing approach Increase of the amount of activity |
| user's perspective         |                                                               |                                                               |                                                               |                                                               |                                                               |                                                               |                                                               |

TABLE 1: INDICATORS OF THE E-LEARNING PROCESS

VII. DISCUSSION AND CONCLUSION

The idea that an e-learning course may be obtained simply by using an LMS (Learning Management System) platform, for instance, Moodle or Dokeos, in which one introduces lecture notes or a book that must be read by the student and a final test so as to evaluate its assimilation is considered ridiculous by most teachers. Every e-Learning initiative is unique and therefore it has its own features which differentiate it from another one. One cannot structure a model that fits all e-Learning courses. On the contrary, every e-Learning initiative should have a structure tailored to meet the needs and the specific situation of the student.

Yet the attention mustn't be focused only on the structure of the online course but also on the entire learning process that the structure must support.

This article dealt with the learning process and starting from Chickering's considerations [18] (“seven principles”), therefore from the fact that there are common ideas that may be usefully applied in many if not all the e-learning situations, the article tried to find and present a simple method for the evaluation of an online learning process: for this reason the article took into consideration and analyzed activities for secondary schools, upper schools and university students.

This method, based on a series of indicators, may be useful as a means of support in the use of the - often scarce - resources (not only economic but also structural) of the educational institutions, in designing and realizing new online course or improving existing courses.

It is an empirical methodology that provides results expressed in numbers that may be analyzed and then used in order to compare the effectiveness and the efficiency of an e-learning process. Finally, it is a method that may be improved by greater experience, that is to say, by applying it to a large range of educational institutions and contexts.

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