Διεθνές Συνέδριο για την Ανοικτή & εξ Αποστάσεως Εκπαίδευση

Τόμ. 6, Αρ. 1Α (2011)

Εναλλακτικές Μορφές Εκπαίδευσης

Microphysics of E-Learning Tutor: GT Brain™

Bruno Gaetano Ronsivalle, Mezzetti Cinzia, Pellegrini Daniela, Apostoli Angelo

doi: [10.12681/icodl.761](https://doi.org/10.12681/icodl.761)

Microphysics of E-Learning Tutor: GT Brain™

Bruno Gaetano Ronsivalle
"Sapienza" University (ITALY)
Professor
bruno.ronsivalle@uniroma1.it

Mezzetti Cinzia
Label Formazione (ITALY)
General Manager
cmezzetti@labelformazione.it

Pellegrini Daniela
Label Formazione (ITALY)
Project Manager
dpellegrini@labelformazione.it

Apostoli Angelo
Label Formazione (ITALY)
Instructional Designer
aapostoli@labelformazione.it

Abstract

Defining a tutoring model is one of the most significant factors in order to get an effective e-learning course. Tutor's activities are fundamental and, in case of courses with a large number of students, they must follow at least two different directions – which implies the coordination of two different professional figures:

(1) the contents tutors;
(2) the process tutors.

In reference with the process tutor activities, the authors elaborated an experimental model in order to get an expert system, *GUARDIAN TUTOR™ 1.0*. The model is based on an artificial neural algorithm - *GT Brain™* - able to learn from experience and define some management strategies to monitor the activities and intervene in the process.

In the present paper we'll examine the experimentation first results, while emphasizing next points:

- identification of the quality indicators structure: such indicators are the criteria to train the neuronal network;
- definition of the variables set, to determine the project evolution;
- description of the specific neuronal structure and the learning algorithm;
- definition of the network training activities;
- analysis and interpretation of the network training activities results;
- generalization of data and definition of tutoring activities management rules in the *GT Proactive™* module.

Keywords: *Tutoring, Neural network, E-learning*

1 INTRODUCTION

A distance-learning course, especially in case of self-study activities, must be sustained by a specific professional profile: the tutor. A tutor must encourage motivation, facilitate communication and help to strengthen the learning process.

The term "tutor" – from Latin verb "tutari" – originally means "to protect, defend, take care". Nowadays, in an adult learning context, a tutor is a professional profile able to perform behaviors in order to promote the system efficiency and the learning course effectiveness for students.

1.1 The process tutor (PT)

More specifically it's possible to distinguish the tutor intervention typologies depending on competencies and action areas:

- Informative and technical operational area – "basic tutor" competence. (BT)
- Methodological area – "process tutor" competence. (PT)
- Contents area – "contents tutor" competence. (CT)

In this paper we'll refer to the PT (process tutor) competencies in e-learning projects. Tutors tasks include: giving methodological and organizational help; providing directions and hints about how to correctly use the learning environment; follow the course rules and manage the study time. Tutors functions resemble to an actual "direction" activity in the learning process, as they're aimed at making students progress, solving critical situations, defining intermediate objectives, helping the learner to attain intermediate and final outcomes.

PT activities evolve in precise temporal interventions, as:

- the reception within the system;
- the constant monitoring of the learning activities;
- the analysis of the course reports;
- the communication to students and learning path actors.

On the other hand, a PT has also some management tasks. He establishes the learning deal with the students, he supports their motivation and helps them to solve study problems. He also encourages the tests performances: he gives feedback according to the contents expert standards and, consistently, uses quantitative and qualitative tools to monitor and address the adequate behaviours in order to attain the expected results.

It's a professional profile combining methodological and managerial technical-specialist competencies. His role can be irreplaceable in complex projects (including blended courses) with more than 100 students.

1.2 Critical facets in PT activities

From last years experiences we could identify and classify the more critical situations about the PT activities, in particular the management of complex e-learning projects, requiring the presence of a variegated didactic staff and the management of big users group.

In this kind of project we identified some recurrent phenomena like:

- Patchy interventions: when it comes to big numbers it's possible that the different actors activities overlap: so it's fundamental for all the staff to follow a common agenda and share the intervention plan.
- "Blurring" process: the presence of big numbers can affect the capability of highlighting the differences. Then all the different interventions can become a group phenomenon, even if the situations and behaviours have nothing in common.
- Time dilatation: in big group management the intervention time can increase because of the management and analysis of complex monitoring data.
- Simplification: the presence of big numbers hampers the possible intervention in learning processes. Then the activities can be interpreted in terms of "completion" status, inactivity, drop out and so on. That means particular factors determining specific users status can't be understood.

1.3 Artificial intelligence systems to back PT activities

E-learning projects bonds allow us elaborating some strategies consistently with the development objectives and supplying some effective and customized support for single users and groups.

Once the critical facets identified and classified, we oriented the research by defining a tutoring model that could integrate an intelligent system and allow a more efficient and effective management of tutoring activities.

GT Brain™ system implementation represents a first valid answer to the described phenomena. If an artificial system manages autonomously all standard communications, then the PT will be able to spend more time monitoring single students and group learning process.

2 METHODOLOGY

Our goal is showing the research results in order to implement the GT Brain™ and GT Proactive™ modules of the GUARDIAN TUTOR™ 1.0 system, a platform for the process tutoring activity.

2.1 The four steps of the research

There are four steps to this research process. Each step corresponds to specific activities and outputs:

- Step 1. Activity: Definition of the variables set and the quality indicators
  Output: Table with inputs and outputs of the RNA GT Brain™ module
- Step 2. Activity: Definition of the neuronal structure and the learning algorithm
  Output: Functional structure of the RNA GT Brain™ module
- Step 3. Activity: Analysis and interpretation of the network training activities results
  Output: Table of weights of the RNA GT Brain™ module
- Step 4. Activity: Generalization of data and definition of tutoring activities management rules
  Output: Table of the conditional rules founding the GT Proactive™ module.

2.2 Analysis of two concrete cases

In order to make the different results activities more relevant, we decided to apply the model to two e-learning projects about Safety in the working environment. So we studied and interpreted some data from Label Academy database, the LMS platform used to supply the training courses and administer the tests.

In particular, it's about two concrete applicative cases in adults training, both very complex and attended from a high number of students (774 students, to be more specific):

- Project 1. Field: "Consulting Technology Outsourcing" company
  - Number of students: 300
  - Contents typology: refresher course about Safety in the working environment
  - Methodology: distance learning self-study
  - Course length: 4 hours of study
  - Edition length: 3 weeks + 1 week extension
  - Tutoring typology: first level HelpDesk and ProcessTutoring
  - Learner typology: predominantly young students (27-40 years old) working at a consultancy firm, accustomed to manage work-

overcharge situations and observe deadlines. They're also highly educated (many graduate-professionals) and with informatics skills.

- Project 2: Field: Agriculture
  - Number of students: 274
  - Contents typology: refresher course about Safety in the working environment
  - Each course included different traditional classes modules and a distance-learning module about Safety in the working environment (D.lgs. 81/2008), available right from the start of the course.
  - Methodology: distance learning self-study
  - Course length: the distance learning module length is 8 hours.
  - Edition length: the course average length is approximately 2 months and a half.
  - Tutoring typology: first level HelpDesk and ProcessTutoring
  - Learner typology: local labour union employees. The age range is 40-50 years old and the population looks heterogeneous about informatics skills and technological equipment.

2.3 The reference data

The analysis of the information concerning the two e-learning courses in order to define a GT Brain™ neural network has started from the following typologies of data recorded from Label Academy platform. This activity observed the e-learning tracking international standards:

- Platform accesses
  - First and last access
  - Total number of accesses
  - Total length
  - Details about every single platform user
- Courses statistics
  - Number of students
  - Fruition total time
  - Total time for each course activity
  - Total time for each monitored activity
  - Details about students fruition time for the monitored activity in terms of: entrance/exit date/hours for each activity access
  - Obtained score (in case of activities like tests, WBT AICC and so on)
  - Activity status: complete, incomplete, fruition percentage (in case of WBT activities)
- Students statistics
  - Number of completed activities out of the expected course activities
  - Fruition total time
  - Number of accesses to the course
  - Last access date
  - Total time for each kind of activities (for instance the total time required for the course WBT activities)
  - Total accesses relative to activities typologies
  - Number of completed activities
  - Last fruition date
- AICC statistics
  - AICC activity total time fruition

  - Total number of accesses
  - Activities status (completed, started, to be started)
  - Number of completed/expected activities
  - Time and score for each AICC unit
  - Time and score for each AICC unit access
- User report book
  - Course total time
  - Total number of accesses
  - Achievement percentage
  - Course status
  - Details about every single student fruition time and corresponding score

3 STEP 1: DEFINITION OF INPUT AND OUTPUT OF GT BRAIN™

First step of the project was defining the data structure that is needed to feed GT Brain™ module engine. We decided to keep the maximum level of detail about the projects evolution by extracting and elaborating information about users activities and corresponding tutor actions. In addition, consistently with our experience, each project was fragmented in 4 sequential moments and sometimes a 5th step ("extension") was included. This allowed analytically describing the behaviours features on a general level by referring to the learning process single steps as well. In this way we could ponder the *ad hominem* tutoring intervention effectiveness, depending on the expected results. The results were extracted from the fruition data ("completion status") and from the assessment tests results ("effectiveness index") in order to make the training pattern definition of the GT Brain™ artificial neural network (ANN) possible.

More specifically, the Label Academy database information was distributed in two main groups: INPUTS and OUTPUTS of the neural network. The first one was declined in four sub-groups, depending on the typology and the nature of the data under examination. Thanks to this classification we defined the following structure for all of the 774 records of the training pattern, corresponding to the 774 students:

- INPUT: input constants and variables for the ANN training
  - Project constants, referring to the course general features, valid for all participants and defined, once for all, upstream of the process.
    - Project typology
    - Project length (calculated per day)
    - Expected general fruition time (calculated per minutes)
    - Expected single step fruition time (calculated per minutes)
  - General fruition variables in relation with single users
    - Initial test (initial test results in hundredth)
    - Final test (final test results in hundredth)
    - Actual fruition time (calculated per minutes)
  - Fruition analytical variables in relation with single users and related to one of the learning path five steps.
    - Actual fruition time in relation with single moments (calculated per minutes)
    - Completion status in relation with single moments
  - Tutors actions corresponding to single users in relation with one of the learning path five steps.
    - Users account assignment

        - Course start memorandum
        - Answers to users reports
        - Reminder for users attending the course
        - Reminder for users not attending the course
        - Extension
        - Completion automatic mail
        - Motivational phone call
        - Communication by the customer
- OUTPUT: variables depending on ANN
    - Quality criteria
        - General completion status for each single user (%).
        - Effectiveness index resulting from the ratio between the added value and the learning need (Range: 0 – 1).
        - Composite index completion/effectiveness (Range: 0 – 1).

4 STEP 2. DEFINITION OF THE ANN OF GT BRAIN™

Once the training structure identified, it was possible to define the artificial neural network structure that is the "brain" of the whole system.
By building the ANN logical structure, we adopted a neuron three-layers model – input, hidden neurons and outputs -, with a sigmoidal activation function:

$$f(x)\frac{1}{1+e^{-x}} \text{ ,}$$

whereas $f(x)$ represents the neuron activation function, e equals the "Napier's constant" (2,718281828...) and x is the accesses weighted sum.
Thanks to two owner software for neural automata, Alyuda NeuroIntelligence™ Version 2.2 (577) and Neural Applet Version 4.3.8, it was possible to rigorously check the optimum structure (connections types, number of intermediate layers, learning rhythm and so on) in order to manage the two courses data.

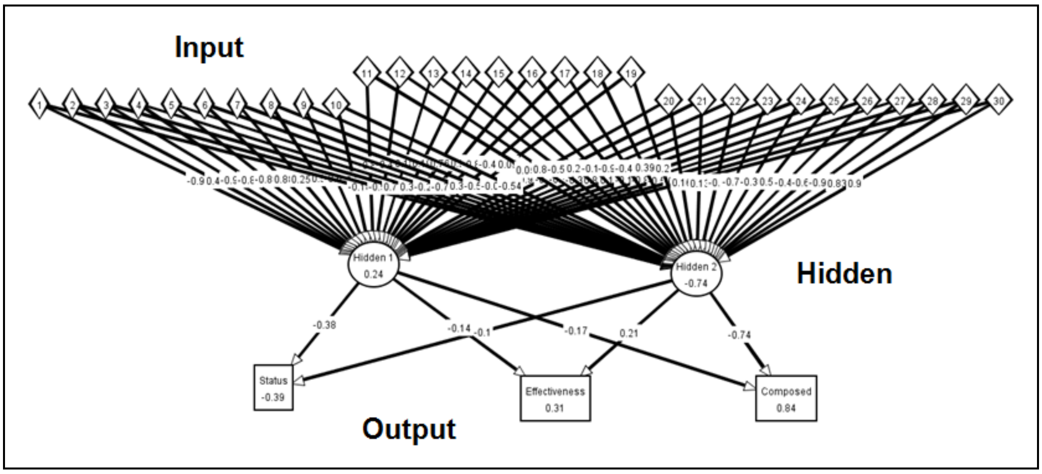

Fig. 1 The GT Brain™ ANN logical structure

This entailed a gain time and allowed identifying the more effective training algorithm in order to accelerate the ANN convergence, a Quick Propagation algorithm (that is a heuristic modification of the Back Propagation algorithm).

5 STEP 3. ANALYSIS OF THE ANN TRAINING ACTIVITIES RESULTS

In the testing and validation phase of the ANN training, we verified the existence of three remarkable neural network features and the selected data structure in order to describe the phenomenon under examination:

- The extreme speed ANN gets the optimum convergence level (after about 6000 repeated actions), as in Fig. 2. That means the selected information and the adopted model well represent the mechanism of tutoring activities and their effects in terms of learning courses effectiveness and efficiency;

Parameters

	Training	Validation
Absolute error:	0,000041	0,149377
Network error:	3,33E-08	0
Error improvement:	1,14E-11	
Iteration:	6001	
Training speed, iter/sec:	909,2427	
Architecture:	[31-15-1]	
Training algorithm:	Quick Propagation	
Training stop reason:	All iterations done	

Fig. 2 Parameters of the ANN training activity

- The high degree of correlation (about 0,85) between the ANN outputs values and the expected values. This facet (easy to infer from Fig. 3 and Fig. 4 data) represents a further confirmation in favor of the methodological consistency of the neural tool used to analyze data;

Summary

	Target	Output	AE	ARE
Mean:	0,67611	0,69791	0,0694	0,119769
Std Dev:	0,160344	0,119619	0,0563	0,127058
Min:	0,322903	0,458362	0,000821	0,001014
Max:	0,930231	0,900763	0,23294	0,721394

Correlation: 0,847438
R-squared: 0,441878

Fig. 3 General results of the ANN training activity

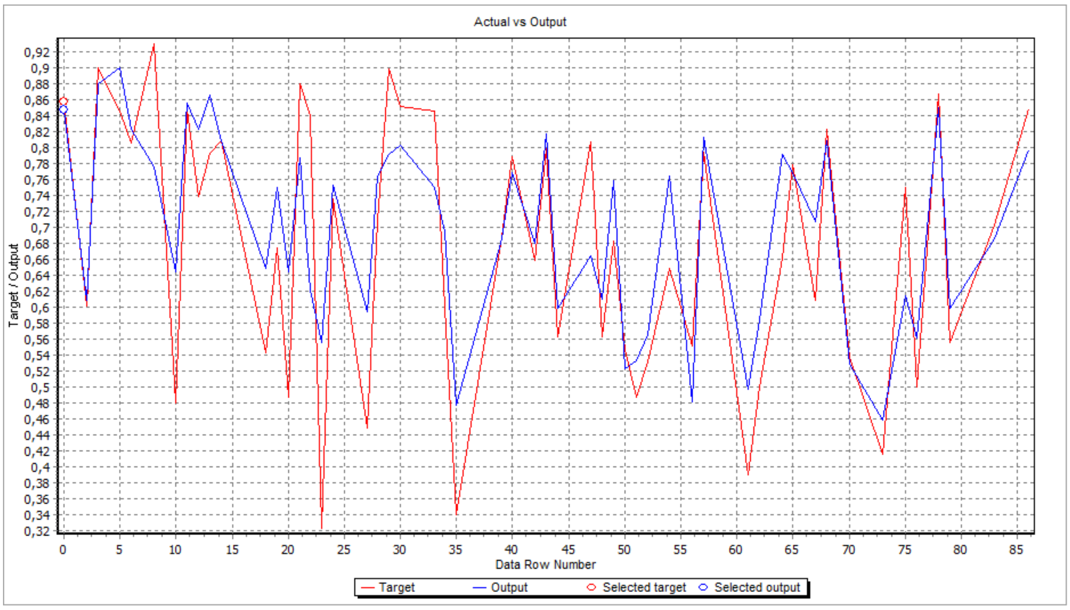

Fig. 4 Degree of correlation between actual and expected Outputs in the ANN testing

- The correspondence between the team tutoring experts perception and the indications about tutoring actions weights, ensuing from ANN training phase data aggregation and interpretation. This confirms the model has a "simple" function: writing out and standardizing the knowledge and experience background of the more expert tutors.

6 GENERALIZATION OF DATA AND DEFINITION OF RULES

The generalization phase of the neural training results and the derivation of the tutoring rules from the neural units weights represents the most important step of our research. And also, the most delicate.

6.1 General methodological considerations

To get some tutoring rules, it's necessary to: (a) define a set of quality indicators to evaluate the training path effectiveness (in our case the completion status, the effectiveness index and the control composite index); (b) identify and fix some conditions and typical events, more or less complex, representing the students behaviours, the interaction with the "course" system, the effects these behaviours usually entail, the so-called "sentinel" risk factors; (c) associate to each behaviour (or to a cluster of behaviours) a set of possible actions the tutor should perform to mitigate the risks about learning path completion and/or its effectiveness.

Our research goal was first selecting and separating data in one of the three categories (quality indicators, system conditions, tutor actions) and then identifying the relations and the possible "rules" that manage the evolution of such dynamic system. With the awareness of which are the complications when it's about studying a complex phenomenon not reducible to some deterministic equations.

Furthermore, in order to correctly integrate the temporal dimension of the learning process with the role and potentialities of the process tutor, we tried to regiment the phenomenon under consideration within a 4-step temporal sequence (or learning moments) and an extension step. This implied the need of declining relations and rules for each path temporal step, in line with the good sense that leads a good process tutor activity.

In this sense, adopting the neural model of analysis and interpretation of this complicate variables tangle was winning. We could define a dynamic taxonomy of the conditions, isolate the more risky factors and derivate in a flexible and precise way the indications for the tutor, case by case, user by user, step by step. That was necessary in order to effectively manage the set goals attainment.

As previously noticed, these rules equal the base algorithms leading the GT Proactive™ model activities. Since they derive from GT Brain™ ANN in real time, they also evolve and are affected by the positive effects of the network continuous and permanent training.

6.2 Tutor's actions: the GT Proactive™ system rules outputs

Before showing the Prima GT Proactive™ functioning system features it's important to schematically describe all the possible actions representing the tutor tool chest, briefly mentioned in Section 3. In this sense we have to precise that each action can be performed at any time and repeated if needed.

6.2.1 *Action 1: Users accounts assignment*

This action is strategic and aimed at:

- Informing participants about how to have access to the course;
- Highlighting the course objectives;
- Specifying the course features (length, modalities, study time);
- Defining rules (prerequisites, check tests and passing thresholds, deadlines);
- Indicating the study plan (in reference to the weekly activities);
- Informing about support services (communicating tutor's references, availability, answer time, reports typologies).

6.2.2 Action 2: Course start memorandum

The "course start memorandum" is aimed at:

- Summing up objectives and course rules;
- Motivating users to attend the course;
- Reminding the platform access modalities and the password;
- Reminding the support services (communicating tutor's references, availability, answer time, reports typologies).

6.2.3 Action 3: Answers to users reports

In this case the PT answers on-demand about interventions registered in the Help Desk system.

6.2.4 *Action 4: Reminder for users attending the course*

This action is addressed to participants having started the learning activities and is aimed at:

- Highlighting the fruition time status;
- Highlighting the importance of completing the course in time;
- Summing up the study time;
- Pushing participants to indicate possible difficulties.

6.2.5 Action 5: Reminder for users not attending the course

Unlike Action 4, this reminder is addressed to participants not having started the learning activities yet and is aimed at:

- Highlighting the course non-participation status;
- Study time remodulation and customization;
- Pushing participants to indicate possible difficulties.

6.2.6 Action 6: Extensions

By performing this action the PT communicates to participants who didn't completed the course in time the redefinition of the new schedule course completion.

6.2.7 Action 7: Completion automatic mail

This action is essentially aimed at communicating to students about the course completion and the final test possible passing (in case this is binding in order to achieve the course).

6.2.8 Action 8: Motivational phone call

If needed, the PT can activate the phone call process in order to:

- explicate the possible problems in relation with the fruition status of the single participant and understand his/her motivations;
- propose and modulate the standard solutions case by case;
- re-motivate the participant active participation.

6.2.9 Action 9: Customer communication

This action is essentially addressed from the PT to the organizational internal referents: the client must send formal reminders about the importance of participating to the process organization and the need of achieving the training process in time and by observing specific rules. This kind of communication allows:

- evaluating the group phenomena and the single situations;
- defining general rules of communication in order to help the group in critical situations;
- demanding the adhesion to possible alternative solutions (for instance the extension availability).

Action	Description
A1	Users account assignment
A2	Course start memorandum
A3	Answers to users reports
A4	Reminder for users attending the course
A5	Reminder for users not attending the course
A6	Extension
A7	Completion automatic mail
A8	Motivational phone call
A9	Customer communication

Table 1 Synthetic table of the different PT actions

6.3 Analysis outcomes and GT Proactive™ rules

The ANN analysis highlighted some interesting facts, concerning the PT actions related to the training process steps and the management of the other kinds of intervention. In general, the research outcomes pointed out the value of the tutoring process in distance learning paths, by focusing on designing and planning activities in order to attain specific goals.

Emphasizing on the design activities entails three general considerations related to the data analysis outcomes:

1. The tutoring macro-design activity turns into the definition of an actual tutoring "strategy", that is the identification of the most efficient sequence of the intervention rules depending on the system conditions and the process

temporal evolution. This strategy is easy to identify and has many transversal facets between the projects under consideration.

2. The single interventions micro-design is fundamental in order to corroborate the strategic options on a macro level, by giving the PT a wide range of tools in order to orient and support participants with some issues. In particular, data highlight the relevance of performing repeated communications through different transmission modalities and in relation with the path strategic cruxes.
3. Adopting a process tutoring strategy is essential in order to guarantee the objectives attainment. In particular, this is observable in the most critical situations not directly connected to the contents design modalities.

6.3.1 The strategic options depending on the "completion" objectives

The first ANN relevant output concerns the comparison among TP actions (A1, A2, … , A9) in the different steps (S1, S2, S3, S4, S5) aimed at guaranteeing an adequate activities completion level by students.

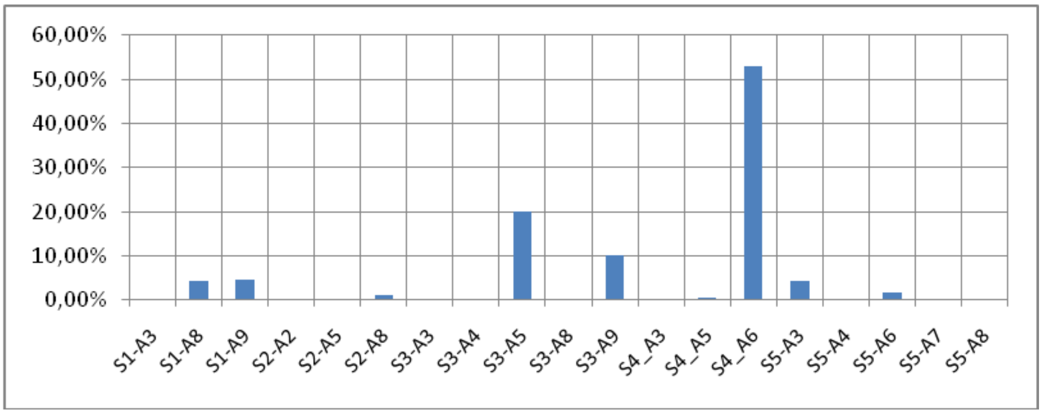

Fig. 5

An analytical interpretation of the Fig. 5 allows identifying TP tactical options in the path different steps. That helps defining the intervention general strategy in contexts such as the ones under examination. In particular, we infer that:

- the first step more relevant actions are A8 (motivational phone call) and A9 (customer communication). In fact in the first phase it's important to create a direct contact with single participants (without the mediation of the LMS) and share the project objectives and the rules of play determined by the organizational context representatives;
- In the second step, the only significant action is A8 (motivational phone call), to confirm the need of adopting some LMS complementary communication tools in order to motivate participants and make them actively participate;
- Actions A5 (Reminder for users not attending the course) and A9 (customer communication) are the step 3 more crucial options and imply the integrated involvement of the students less inclined to observe the rules of play;
- The predominance of the Action 6 (extension) in step 4 corresponds to a common phenomenon in adults distance learning paths: many participants tend to postpone activities (for professional reasons or bad capability of managing time) and concentrate them in the last phase of the path. Thence the need of extending the length of the course (that could leads to think about a preventive strategy, not declared at the beginning of the course);

- In step 5 actions A3 (Answers to users reports) and A6 (Extension) are particularly relevant, in order to intensify the interaction activities with “latecomer” students.

Is this tutoring generalized strategy adequate? It looks like it is, going by the results described in the Fig. 6 that reports the completion average percentage corresponding to the steps of the two projects under consideration.

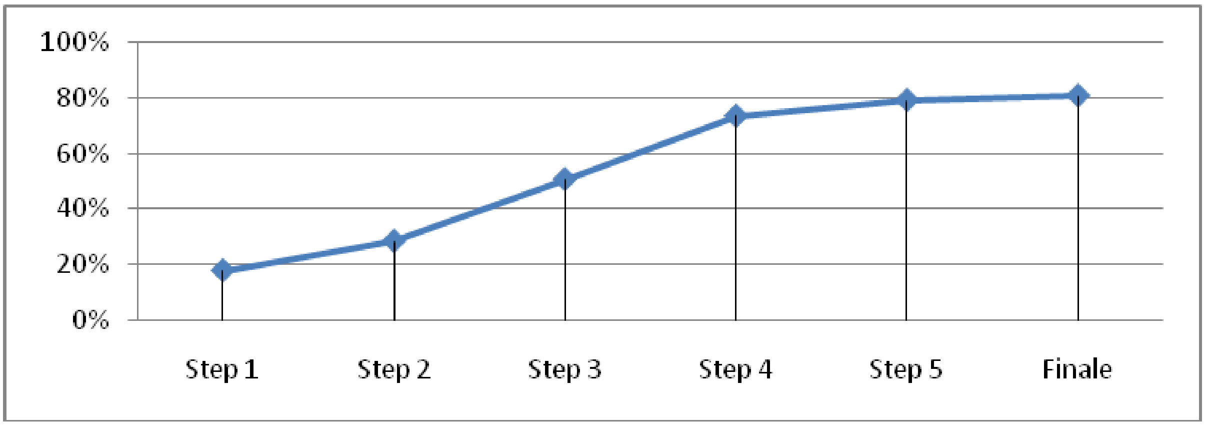

Fig. 6

6.3.2 The strategic options depending on the “learning effectiveness”

The ANN data interpretation gives indications about the more consistent tutoring strategy depending on the attainment of a high effectiveness degree.

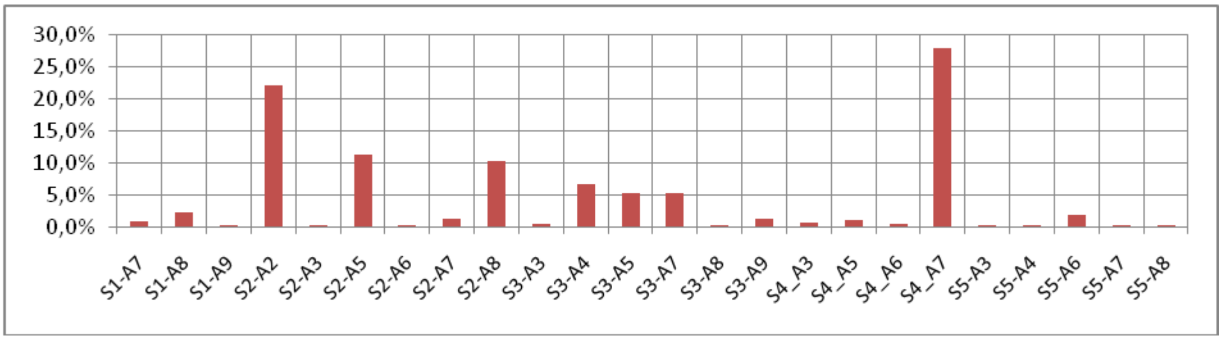

Fig. 7

The Fig. 7 highlights the degree of variability about the relevance of some actions. It also emphasises the difference of perspective the learning effectiveness criterion entails, as it is more complex than the completion index. Unlike what we observed in the previous paragraph, in the second step action A2 (Course start memorandum), A5 (Reminder for users not attending the course) and A8 (Motivational phone call) are more relevant in orienting the final outcomes of the path.

6.3.3 A balanced strategy depending on completion and effectiveness

A cross-analysis of the data related to the actions evaluation depending on the composed index completion/effectiveness let some further indications about tutoring activities emerge.

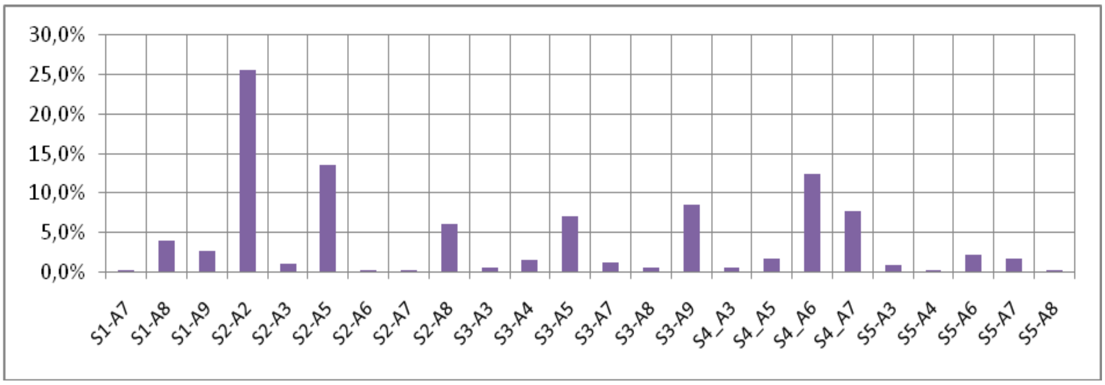

Fig. 8

In particular, the Fig. 8 highlights the importance of some strategic options in order to combine the need of an adequate final completion of the activities with the more didactic need of the learning effectiveness. It's necessary to remark that to satisfy both requisites (activities completion percentage and learning effectiveness) the strategy must mix a higher number of actions corresponding to the course key points.

6.3.4 The strategy declination in specific contexts

The analysis allows declining the general strategy in a set of specific intervention options corresponding to critical conditions recorded in the two processes under examination.

For instance, the graphic (Fig. 9) represents the different degrees of relevance of tutoring actions in relation with a large class of participants who has a completion percentage equal to 0% at the third step of the learning path.

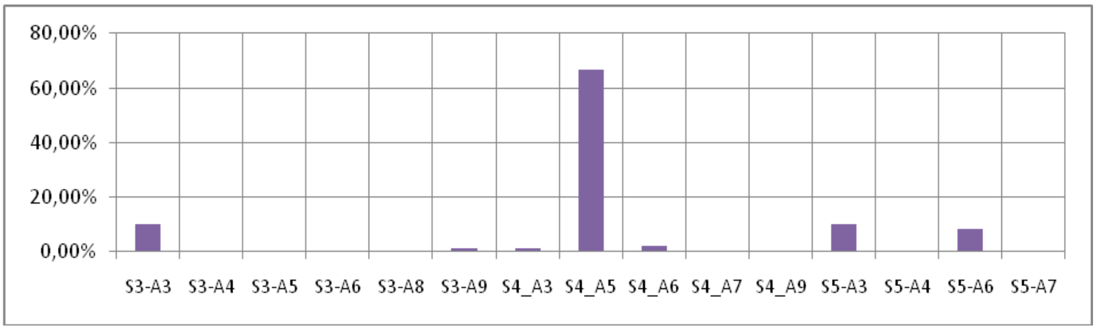

Fig. 9

In this case the strategy to attain the final completion is structured in some interrelated and localized actions distributed in different steps. The graphic results (see Fig. 10) show the adequacy of these actions by representing the evolution of the completion average percentage of the participants sub-class under examination.

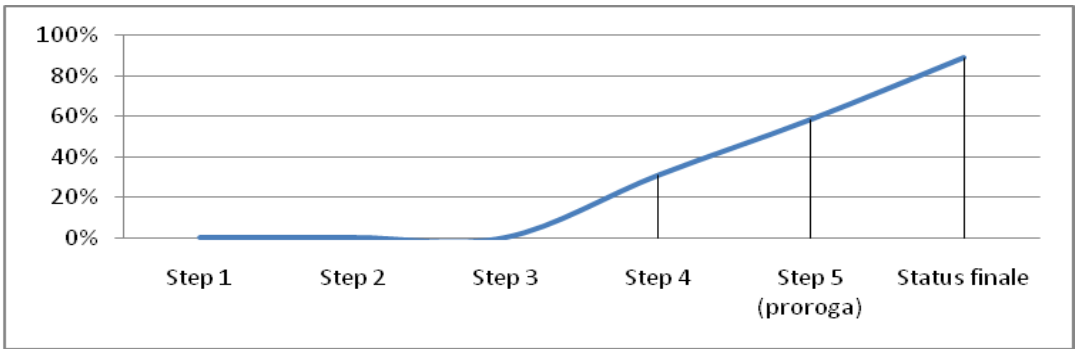

Fig. 10

7 CONCLUSIONS

The GT Brain™ module indications, included in the GT Proactive™ module, are the strategic rules determining the intervention and communication modalities of a process tutor in the monitoring activities of some e-learning path typologies.

Effectively, they can be implemented in order to: (a) support in real time the process tutoring activity management by human beings; (b) promote the activation of an artificial agent able to integrate such rules in the course automatic or semi-automatic check (that is the main objective of our research).

This makes sense in all the cases the high number of students to check and/or the learning path complexity represent a risk factor in relation with the project goals.

In particular, as the results show, adopting an analytical strategy in the tutoring process can contribute to solve the bigger critical situations related to the e-learning course management, as the patchy interventions, the "blurring" process, the time dilatation and the simplification.

Furthermore, beyond the completion perspective, the definition of a quality complementary criterion as the learning effectiveness index can guarantee the substantial value of the monitoring model and orient the attainment of the expected individual learning objectives.

On the other hand, the research contributes to the theoretical debate around the process tutoring "non virtual" models, thanks to the identification of some interdependence relations between variables and the analysis of the clusters emerged in the ANN training phase and the monitoring elements weighting.

That being so, some perspectives to deepen and think about the process tutor role are now open. The outcomes could be having some positive effects in building the artificial agents and the systematizing the existing models.

REFERENCES

Ranieri, M. (2005). *Elearning: modelli e strategie didattiche*, Trento, Erickson

Ronsivalle, G.B., Carta, S. and Metus, V. (2009). *L'Arte della progettazione didattica. Dall'analisi dei contenuti alla valutazione dell'efficacia*, Milano, FrancoAngeli

Ronsivalle, G.B., Pellegrini, D., Orlando, M. and Conte, M. (2008). "The Guardian Tutor 1.0". An Artificial Neural Network As Support To Tutoring System. *Proceedings of ICERI 2008*, Madrid

Rotta, M. and Ranieri, M. (2005). *E-Tutor: identità e competenze*, Trento, Erickson

Salmon, G. (2000). *E-moderating. The Key to Teaching and Learning On line*, London, Kogan Page

Salmon, G. (2002). *E-tivities: the key to active online learning*, London, Kogan Page

Torre, E.M. (2006). *Il tutor: teorie e pratiche educative*, Roma, Carocci

Trentin, G. (2005). *Apprendimento in rete e condivisione delle conoscenze*, Milano FrancoAngeli

Trevisol, G. (2002). *Il Tutor dei processi formativi. Ruoli, Competenze, Formazione*, Milano FrancoAngeli

Trentin, G. (2001). *Dalla formazione a distanza all'apprendimento in rete*, Milano FrancoAngeli