Encourage reflective and self-assessment processes through the automatic processing of personalized feedback

Antonio Marzano[*]

Abstract
Technologies in training processes by radically modifying the relationship with (and between) knowledge, have determined the need to experiment with new methodological approaches to innovate didactic action, respond to subjective training needs, satisfy the ever increasing requests coming from the job market. In this paper, we want to deepen a particular action of this process, preliminary to the implementation phase of each training intervention. We refer to the needs analysis (NA) aimed at identifying training needs and requirements of the participants with respect to which to organize and modulate the contents and the didactic action. In the opinion of the author, already the NA, if accompanied by specific actions, can constitute an intentionally structured moment to enhance the effectiveness of training feedback in a diagnostic and self-assessment function and in this work we will describe an automated system designed and developed specifically for this purpose. To examine the application opportunities and to show the potential of the automated system, an experience will be presented that involved students attending the specialization course for educational support activities for pupils with disabilities held at the University of Salerno in the A.Y. 2022/2023.
Key words: Teacher training; Training Needs Analysis; Customized feedback; Didactic expertise; Diagnostic evaluation.

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1. Introduction

In the last twenty years, in the educational field, research have multiplied and they have attempted to outline a precise picture of the qualifying factors of effective teaching and of the traits connoting teacher professionalism.

[*] Full Professor, Dept. of Human Sciences, Philosophy and Education, University of Salerno. E-mail: amarzano@unisa.it.

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Theoretical models of *Instructional Design*, contributions from cognitive sciences, empirical studies on expert teachers, identifying a set of general principles and recommendations that can be used to improve the quality of the lesson in the classroom (Marzano, Calvani, 2020), have made it possible to acquire significant knowledge on the subject to "what works and in which contexts" and on the features of expert teachers. For these reasons, teachers are required to be continuously updated to enrich their "toolbox", updating disciplinary knowledge, innovating teaching methodologies and, in general, integrating their own set of professional skills. Also Hattie (2009; 2012), in his synthesis works, underlines the close connection among these aspects that are considered essential to build a quality educational relationship.

At the same time, technologies in training processes, by radically modifying the relationship with (and between) knowledge, have determined the need to experiment with new methodological approaches to innovate didactic action, respond to subjective training needs, satisfy the ever increasing requests coming from the job market. Technologies alone do not guarantee the improvement of the quality of training processes, but they certainly represent a "possibility to be exploited" within an overall organic system that is able to combine in a coherent way and at different levels (theoretical, ethical, technical-methodological) the meeting between the expert/trainer and the trainee and the different instances of the actors involved.

With these premises, we want to deepen a particular action of this process, preliminary to the implementation phase of each training intervention (in any area: school, extracurricular, university, adult and professional). We refer to the needs analysis (NA) aimed at identifying training needs and requirements of the participants with respect to which to organize and modulate the contents and the didactic action. This first moment must be considered as essential and integral to the entire training process and on it depends the ability to formulate the learning objectives (fulcrum of the coherence between the demand and the training services provided), elaborate and implement the intervention. In the opinion of the author, already the NA, if accompanied by specific actions, can constitute an intentionally structured moment to enhance the effectiveness of training feedback (Hattie, Timperley, 2007; Marzano, 2022) in a diagnostic and self-assessment function and in this work we will describe an automated system (CustOmized FeedbACk sysTem to suppOrt tRaining, COFACTOR) designed and developed specifically for this purpose at the Research Laboratory in Media Education and Active Didactics (RIMEDI@) of the University of Salerno.

Over the past three years, COFACTOR has been offered to both university students and teachers to test its usability and effectiveness and the results are encouraging (Calvani, Marzano, Miranda, 2021; Calvani, Marzano, Morganti, 2021; Miranda, 2022). After the description of COFACTOR, in order to

examine its application opportunities and potential, an empirical research will be presented. It involved students attending the specialization course for educational support activities for pupils with disabilities (VII cycle - Secondary School) held at the University of Salerno in the A.Y. 2022/2023.

2. The COFACTOR system

COFACTOR is developed through four distinct sequential actions (Fig. 1). The user, after providing their data, answers an online questionnaire by filling out a *Google Form*; the items present typical situations of work experience and, with respect to the individual situation, a possible answer/solution is hypothesized. The interviewee is asked to evaluate in terms of agreement or disagreement (on a scale from 1, totally disagree, to 5, totally agree) with reference to the proposed answer/solution (*Input*). Once the compilation is complete, the user sends the questionnaire (*Output*) and the system, after having processed the answers (*Process*), sends a personalized feedback to the e-mail address previously provided by each participant which indicates the overall percentage of consistency between the expected behaviors and the answers provided in relation to the situations/solutions proposed, giving for each item a specific explanatory message from the expert point of view with which the expected answer is argued (in case of discrepancy) on the basis of the scientific evidence available (*Feedback*).

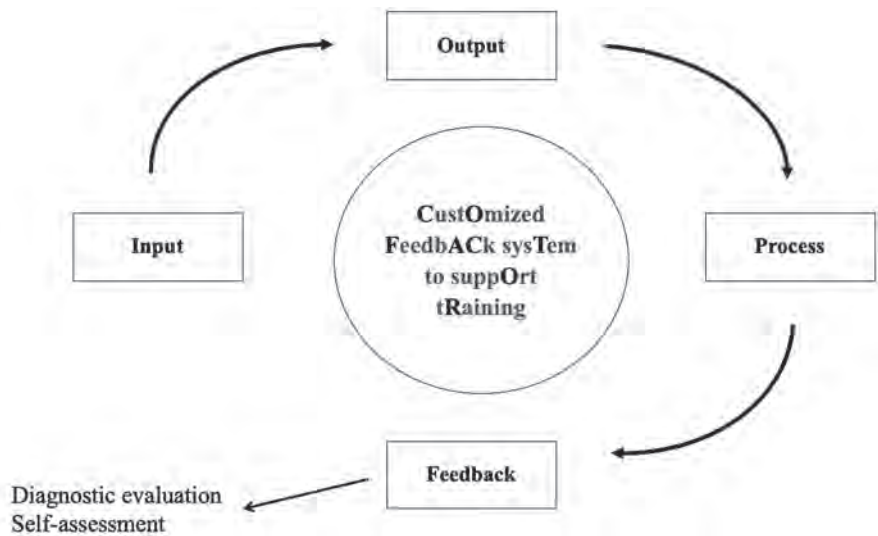

Fig. 1 - COFACTOR system (Marzano, 2022)

The expert/trainer can manage an online *dashboard* that allows viewing a report on the percentages of correct answers provided by the participants with respect to the expected behaviours. Among the many actions envisaged, there is also the possibility of requesting the completion of a questionnaire (for example, of satisfaction) at a later time (through a link inserted in the e-mail received from each participant).

The use of COFACTOR does not end with the sending of personalized feedback: we do not attribute to the feedback a procedural connotation of a purely informative nature (Boud, Soler, 2016) and, on the other hand, the exclusive use of stimulus-response/feedback combination does not guarantee the improvement of the participants' performances (teachers or students) (Hattie, Timperley, 2007; Earl, 2012; Hattie, Donoghue, 2016; Pereira et al., 2016).

Feedback is formative when it contributes to the development and consolidation of knowledge/skills by intervening directly on performance to direct actions towards a shared goal, if it is timely, continuous and exhaustive and when it acts as a *scaffolding* by simplifying complex tasks, outlining "what and how to do" to improve performance (Bransford et al., 1999; Shute, 2008; Grion, Serbati, 2019; Andrade, Brookhart, 2020). Therefore, the action of the expert/trainer plays an essential role: starting from the emerged results (those displayed on the dashboard), he can initiate a comparison to analyse the critical issues, research and share possible solutions (Lipnevich, Smith, 2009; Brown, Harris 2018). This moment translates into actions focused on a dialogic and participatory dimension in which the feedback sent by the system is discussed and deepened through interactive moments, dedicated to the comparison between the expert and the participants, between the participants themselves and when the subsequent training meetings are coherently organized and represent a continuum harmoniously integrated with the initial NA.

3. An application of COFACTOR in the training field

Over the past three years, COFACTOR has been offered to both university students and teachers to test its usability and effectiveness and the results have been encouraging. Further details are in the already published papers (Calvani, Marzano, Miranda, 2021; Calvani, Marzano, Morganti, 2021; Miranda, 2022; Vegliante, Marzano, Miranda, 2022).

In this paper, to show its potential, the results of a study will be presented which involved 190 students attending the specialization course for educational support activities for pupils with disabilities (VII cycle - Secondary School) held at the University of Salerno in the A.Y. 2022/2023.

The aim of this study was to answer the following questions: what do the participants think about the ability of COFACTOR to stimulate reflection and self-evaluation processes? Was COFACTOR useful for bringing teachers' points of view closer to the knowledge of effective teaching? Are the examples proposed and the feedback received clear? Were there any difficulties in completing the questionnaire? Were the personalized automatic feedbacks received?

In close relationship with the objectives of the specialization course, the *Effective Teaching Questionnaire* (ETQ)[1] was used for the construction of the inputs (see Figure 1). ETQ is a tool built with the aim of presenting some teaching situations that require an evaluation and bringing it closer, if necessary, to the knowledge of some specific principles of effective teaching. Here, the broad line of research is recalled, which is now also being introduced into Italian literature, allowing us to talk about the foundations of effective teaching. The turning point is given by the recent advances achieved by research in Instructional Design (ID), confirmed from an *Evidence-Based Education* (EBE) perspective. Models of Gagné (1995) and Mayer (2005) on cognitive theories of learning have found substantial confirmation in what research has confirmed through empirical evidence (Calvani, 2011). In this sense, there is a substantial agreement on the fact that, in order to create a context that can favour learning, it is necessary to start from a problem that assumes importance for the students, recall their pre-knowledge or previous acquisitions, show the direction and the objective to be achieved, gradually presenting new information, frequently alternating practice, providing continuous feedback, stimulating reflection on the procedures followed, varying forms and ways of application, recalling knowledge over time (Gagné, Briggs, 1974; Reigeluth, 1999; Merrill, 2002; Rosenshine, 2012; Bell, 2020).

This scenario allows us to extrapolate a first idea of didactic expertise, considered as the set of all those factors connected to the actions indicated above. Even with the awareness of the complexities of the notion of didactic expertise, tools are needed to a rapid approach to this concept, passing in particular through comparisons between the behaviors, the points of view of teachers and those of subjects who can be considered experts. ETQ is a tool that has precisely the purpose of allowing this comparison by highlighting the components (knowledge, attitudes, opinions and mental frames) possessed by teachers and which can constitute decisive factors for effective teaching. The contents of the items are taken from typical situations of classroom teaching which have been the subject of a preliminary evaluation by a group of experts

[1] ETQ was conceived by Antonio Calvani (2014) and saw its first systematic application on teachers in service in the school and trainees of Primary Education Sciences in 2019 (Menichetti, Pellegrini and Gola, 2019).

in EBE research. For each situation (an event or a behavior to be adopted) possible answers are hypothesized which, on a scale from 1 (totally disagree) to 5 (totally agree), express a behavioral logic to be adopted and therefore allow to indicate how much it is reasonable to agree or disagree with that logic.

ETQs has been modified since its first elaboration. From the 2019 version, consisting of 86 items (for didactic convenience, attributable to four operational dimensions: planning, cognitive, management and evaluation), there is a fourth version (ETQ4) consisting of 68 items (Miranda, 2022), actually reduced to 62 items[2] and adapted, to be used with students attending the cited specialization course[3], to their real training needs.

Considering the total number of items, ETQs was divided into four sections and administered in four successive lessons (from October to November 2022). At the end of each administration, the results sent to each participant[4] (Feedback, see Figure 1) were the subject of collective discussion in order to allow greater awareness of all those aspects that could potentially interfere in the development of an adequate level of expertise. Primary attention was placed on the items that presented the greatest dissonance with respect to the expected response to solicit reflections and revisions on the points of view held.

Many of critical issues recurring in the various versions of ETQs administered in the last 4 years concern mental frames, myths or naïve beliefs that anchor also (future) support teachers in positions that, in general, they do not hold scientific evidence on effective teaching. In this paper not all of them will be presented. So, for example[5], most of the 190 students attending the specialization course, showing little knowledge of cognitive load theory and the consequent need to avoid overload, ignores that increasing the information provided (items 1h, 1m, 8h) or intensifying the use of multimedia, not means improving learning (items 1r, 8b, 8g). Then, it is not clear the difference between superficial knowledge and deep knowledge (item 2b, where to make a computer drawing later having studied a topic is seen as the transition from the first to the second) and it is not correct the approach to both formative assessment (i.e., items 3a, ignoring the importance of giving immediate feedback) and summative assessment (i.e., item 4a, identifying a visit to a planetarium with an interview with an expert as a good way of verifying

[2] ETQs is accessible at the following link: https://drive.google.com/file/d/1FXfCwycgZWjJolz4NlOzfnDMCG_RYHnf/view?usp=sharing.

[3] New technologies for learning (ICT), 75 hours.

[4] COFACTOR processes the personalized feedback which indicates, in a first part, the percentage of how much the participant is in line with the expected behaviours in relation to each dimension and then, in a second part, the comparison item by item between the expected response and that provided, and the specific feedback.

[5] We present some critical issues found considering only the items that presented a dissonance with respect to the expected response with values greater than 90%.

learning). More complex and specific implications emerge in relation to the organization of the lesson and its preliminary planning. For example, before entering the classroom, it is not considered important to have a precise idea regarding the duration of the activities and their conclusion (item 1g), or to communicate to the students at the beginning of the lesson where to "get " (item 1l), or, again, to have clear learning goals in the form of activities that students must be able to complete at the end of the lesson (item 1i). Finally, there was a persistent naive view on the issues of inclusion and disability (i.e., items 10b, 10c, 10d, 10e, 11b).

After the administration of the last section of ETQs, a second online (anonymous) questionnaire was proposed. In Fig.2, next to the 9 proposed statements, averages and medians of the degree of agreement of the participants are presented (on a scale from 1, not at all agree, to 5, totally agree).

Express your degree of agreement with the following statements:	**Mean**	**Median**
1. The situations proposed in the questionnaire are useful for bringing the teachers' points of view closer to the knowledge of effective teaching.	4.1	4
2. The situations proposed in the questionnaire have favoured a reflection on my didactic action.	3.9	4
3. The feedback received has stimulated me to improve the ability to reflect on my didactic action.	3.9	4
4. The feedback received stimulated me to analyse the way I work in the classroom.	3.8	4
5. The examples proposed are clear.	3.8	4
6. The feedback received is comprehensive.	3.1	3
7. The feedback received is clear.	3.6	3
8. I found it difficult to fill out the questionnaire.	1.9	2
9. I received the feedback immediately after submitting the questionnaire.	4.9	5

Fig. 2 - The results of the questionnaire

After this brief description of the context of the research and the methodology used, the research questions outlined above can be answered. On average, students agree that the situations proposed in the questionnaire have been useful for bringing their points of view closer to the knowledge of effective teaching, encouraging reflections on their own teaching actions (items 1, 2). With regard to the received feedback, the perceived effectiveness was similarly recorded regarding the ability of the feedback to stimulate reflection

and analysis of one's own didactic action in the classroom (items 3, 4). The item "The feedback received is exhaustive" obtained a lower average degree of agreement while the examples proposed are considered clear as well as the feedback received (items 5, 7). Almost no difficulties were encountered in completing the questionnaire while feedback was received from all participants, with the exception of five students who entered their wrong e-mail addresses. These data are encouraging and confirm the positive judgments that the students themselves expressed informally during the meetings.

Finally, the findings that emerged provided significant elements to recalibrate the system and enhance those dimensions that were found to be more critical than the others.

4. Some concluding reflections

The results of the empirical research that we have described in this paper allow us to propose some concluding reflections and, at the same time, to identify some prospects for future works that seem particularly interesting.

Training activities imply the assumption of a model, even implicit, about the desired behaviour that teachers have to demonstrate. In this sense, by assuming that the models adopted are transparent, reliable and ethically acceptable, it is necessary to try to analyse in a more specific way the components that become part of the teaching expertise. It brings together knowledge, cognitive attitudes, specific abilities, of different nature and thickness; mental frames relating to the nature of learning and teaching, but also lack of information, naive beliefs and myths, constitute a complex inner world of teachers (or future teachers) which affects their decision-making processes and distinguishes their levels of expertise. Of particular importance are the cognitive traits that Hattie (2012) defines as "mind frames" concerning the way of conceiving teaching, the expectations or otherwise that the teacher places on the students. Teachers who develop these ways of thinking are, according to Hattie, more likely to have a major impact on students' learning. The most important mental frame concerns the fact that teachers see their activities not carried out generically to teach, but to generate and seek impact on the students' learning. The area of expertise must therefore be limited by selecting representative situations and cases able to make these crucial circumstances being objects of specific and focused training (Crandall, Klein, Hoffman, 2006; Calvani, Marzano, Morganti, 2021).

For these reasons, we have thought it of some interest to propose in this work a training model which, by favouring the activation of reflexive and self-evaluative processes, can solicit the participants to bring to light possessed schemas and mental models, to favour the comparison with those of expert

teachers, to promote the revision of naive or false conceptions, of stereotyped ideological frameworks (real "didactic myths"; Calvani, Trinchero, 2019), of beliefs not supported by experimental evidence (for example, that "pupils learn better if let yourself experience" or the one according to which technologies improve learning). In our opinion, the experience described in this paper represents an exemplary model to be considered in order to design a training course effectively and pertinently. Using this approach, it is not only possible to adapt the interventions to the contextual and individual characteristics, but it is possible to favour the promotion of personal empowerment which can be translated into actions aimed at improvement.

The model has been applied so far for training of in-service teachers and of university students. Nevertheless, in addition to being able to constitute a preparatory action for numerous training activities (for example, guided discussion with experts, practical observation, modelling), it is possible to hypothesize the extension to other training areas or to different disciplinary domains.

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