MACHINE LEARNING PREDICTIVE MODELS: LIMITS, CONDITION AND APPLICATION POSSIBILITIES IN EDUCATIONAL CONTEXT

MODELLI PREDITTIVI DI MACHINE LEARNIG. CONDIZIONI E POSSIBILITA' APPLICATIVE NEI CONTESTI EDUCATIVI

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ABSTRACT
According to G. Floridi (2023), the spread of artificial intelligence in everyday life contexts determines, on a general level, a process of "wrapping" the real world around the virtual world. Based on this process "è l'ambiente ad essere progettato in modo da essere compatibile con i robot, non il contrario…avvolgiamo microambienti attorno a robot semplici per adattarli ad essi" (Floridi, 2023, p. 56). Machine Learning represents the form of artificial intelligence specifically oriented towards the management of learning processes, and its dynamisms (Binary Classification, Multiple Classification, Clusterization, etc.) can be considered as the anchor point around which teaching contexts are increasingly "wrapped". The purpose of this reflection is to place under observation the ML procedures with the greatest predictive impact, with the aim of verifying their conditions, limits and adaptive possibilities in order to the variables constituting the teaching-learning processes.

L'emergere dell'intelligenza artificiale nelle sue diverse forme e la sua diffusione nei diversi contesti di vita comporta l'emergere di una tendenza specifica del nostro tempo: "è l'ambiente ad essere progettato in modo da essere compatibile con i robot, non il contrario…avvolgiamo microambienti attorno a robot semplici per adattarli ad essi" (Floridi, 2022, p. 56). Il Machine Learning rappresenta la forma di intelligenza artificiale specificatamente orientata alla gestione dei processi di apprendimento, al punto tale che i suoi dinamismi (Classificazione binaria, Classificazione multipla, Clusterizzazione, ecc.) possono essere considerati come il punto di ancoraggio attorno al quale vengono sempre più spesso "avvolti" i contesti didattici. Lo scopo della presente riflessione è quello di porre sotto osservazione le procedure di ML a maggiore impatto previsionale, allo scopo di verificarne condizioni, limiti e possibilità adattive rispetto alle variabili costitutive dei processi di insegnamento-apprendimento

KEYWORDS
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Introduction

Edgar Morin, one of the greatest scholars of complexity, states that, even if we know precisely the facial muscles that we use when smiling or crying, this is not enough to know the reasons why the person laughs or cries. Likewise, “se vedo un bambino in lacrime, mi accingo a comprenderlo, non misurando il grado di salinità delle sue lacrime, ma ritrovando in me i miei sconforti infantili, identificandolo con me e identificandomi con lui” (Morin, 2001, p. 99).

Moreover, the perplexity that affects the empistemic processes aimed at obtaining knowledge from the qualities of objects is also found in the reflections of other authors who, albeit with different declinations, have affirmed the insufficiency of epistemic procedures focused on classificatory processes.

The tendency to place objects within general classes (starting from the characteristics and their interaction), is considered as a procedure which, if on the one hand it establishes relevant interactions between the variables under examination, is not, however, capable of drawing on the reality of the object to which these interactions refer (Pekins, 2000, pp. 166 ss).

The position that, more than others, highlights this critical attitude can be identified in the conclusions of the well-known mental experiment of the Chinese room, carried out by J. Searle in the last decades of the last century (Searle, 1985, 1998).

He also imagines receiving from the outside (through the crack) a set of words in Chinese (a language he does not know) and having to return to the outside correctly formed sentences in Chinese.

In this situation, the only resource available to tackle the task is a set of rules that are used to correctly assemble the sentences.

Based on these premises, Searle concludes the experiment by stating that he, despite his lack of knowledge of Chinese, would be able, using only the rules, to construct correctly formed Chinese sentences, even if these would still remain meaningless to him.

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The meaning of the criticisms aimed at classificatory systems originates from these conclusions.

In more specific terms, the focus of the critical findings revolves around the principle according to which knowing an object means being aware of the contents of experience to which the signs that represent it and their relationships refer. This means that knowledge, defined in this way, requires not only syntactic processes, but also epistemic orientations of a semantic nature.

For these reasons, epistemic processes of a classificatory nature, based on formal symbols and the related association rules, are able to achieve only the first of the two components (the syntactic component), but are completely inadequate to achieve the second (the semantic component).

The conclusions just described show far-reaching implications, which go beyond strictly epistemic boundaries and involve the specific domain of artificial intelligence. Artificial intelligence algorithms are completely syntactic and for this reason they cannot reproduce human intelligence, which, in addition to being syntactic, is also semantic (Searle, 1988, p. 8 ss).

The predominantly formal and syntactic configuration of artificial intelligence can be recognized, according to Floridi, in the fact that it, despite showing performances very similar to those recognized as intelligent, cannot, simply for this reason, be defined as "intelligent". (G. Floridi 2023, pp. 44ss). In this sense, according to the author, the artificial intelligence“non ha nulla a che Vedere con il pensiero, ma esclusivamente con il *comportamento*: se un essere umano *si comportasse* in quel modo, quel *comportamento sarebbe* definito intelligente. Non significa che la macchina sia intelligente o addirittura stia pensando” (*Ivi,* p. 44).

In other words, according to this vision, artificial intelligence would only have the ability to "assemble" symbols based on a system of associative rules specific to man, but would not in any case have the ability (specific to human intelligence) to understand the semantic content of such "assemblies".

The profile of these reserves takes on an important role not only in the general reflection on the real potential of Artificial Intelligence, but also with respect to the possible relationships between this resource and the emotional components of subjectivity.

The purpose of the following pages is to focus on the variables that intervene in this relationship, with the aim of verifying the conditions and limits of its possibilities in educational contexts

1. Communicate emotions

The reflection around the dynamisms that can regulate the interaction between emotional intelligence and artificial intelligence can find an anchor point in the models that formalize the effective (or ineffective) expression of subjective experience.

The considerations made in the previous paragraph, if they prove to be well founded, would have the power to call into question the possibility of establishing a productive and effective relationship with the emotional universe. Starting from this assumptions, in fact, when faced with the expression "the house is not a home", the artificial intelligence would certainly be able to identify the recurrence of a contradiction, but it would not be able to focus on the referent of the word "house" (i.e. the meaning) on which the contradiction itself concerns.

For the same reasons, artificial intelligence would not be able to identify the possible emotional content of these statement, if the latter wanted to refer the negative experience of the subject with respect to the concrete reality of the "home". In this case, in fact, the sentence would continue to make sense despite the contradiction, and yet the artificial intelligence would continue to consider it incorrect, because it would detect in it only the violation of the logical principle of identity.

The verification of the dynamisms that correlate artificial intelligence to the dimension of experience raises the need for a model of emotional communication that acts as a backdrop to the problematization of the entire process.

The epistemic profile of this premise can be deduced from studies in the pedagogical, psychological and didactic area, which, albeit with different declinations, have formalized the variables that support and guide the recognition and expression of emotional contents.

The breadth and articulation of these references does not allow us to carry out a detailed re-elaboration of their assumptions; for these reasons, the following reflection will be focused only on the criteria that govern the effective expression of emotional experiences and, in particular, it will focus the *verbal interaction models* that support or not the communication of such contents.

The choice to anchor the discourse to models of verbal interaction arises from the fact that a significant portion of the emotional contents is represented through mediation systems of a linguistic nature.

On a specifically locutionary level, the enunciative structures that support the communication of emotions are not limited only to identifying whether the different expressions can be classified as positive or negative; they also specify a further articulation of this basic classification, in the sense that they allow us to establish, for each of these categories (positive or negative emotions), which formulations can be considered effective and not effective.

Starting from these premises, it is possible to define an interpretative model that classifies emotional expressions based on four different communicative categories:

a) speech forms that effectively communicate a positive emotion

b) speech forms that ineffectively communicate a positive emotion

c) speech forms that effectively communicate a negative emotion

d) speech forms that ineffectively communicate a negative emotion.

The following table summarizes the breakdown of these expressive typologies.

	Emotion	
	Positive	**Negative**
Effective	a	c
Not Effective	b	d

Table 1: Typology of emotional expressions

The placement of expressions in one of these four categories depends on the presence (or absence) of specific linguistic elements, which allow the two different expressions (whether positive or negative) to be qualified as effective or ineffective.

In general terms, it is possible to state that emotional experiences (whether positive or negative) are verbalized effectively when two fundamental enunciative components occur in them (Franta & Salonia, pp. 74, 120-121):

a) self-representative locutionary behaviour, which consists in the first-person manifestation of current experience. In this sense, the emotion is

communicated effectively if the person explicitly verbalizes "what he experiences... in the here and now of the relationship" (Ibid., p. 74);

b) The verbalization of the "referential index" (Ibid., p. 121), which consists in the description of the fact or situation in relation to which the emotional experience was generated.

In light of these criteria, the expressions:

- "I'm really happy [self-introduction] that you got a good grade [referential index]", which communicates a positive emotion
- "I am very annoyed [self-introduction] by the fact that when I speak you listen to music [referential index]", which communicates a negative emotion

both should be considered effective, because they respect the two previous criteria, and should be placed in quadrants "a" and "b" of the previous table.

In contrast, the expressions

- "you are ungrateful" (showing a negative emotion);
- "you're very good" (showing a positive emotion)

are not recognized (based on the model) as effective, because they omit both linguistic elements described above; they must therefore be placed in quadrants "c" and "d" of the typology table[1].

In addition to the conditions described, the model identifies two other elements that qualify emotional communication (be it positive or negative) as effective or ineffective. The first of these conditions consists in a specification of the referential index, in cases where it concerns the description of behaviors referring to someone. In this case, emotional communication qualifies as effective if it verbalizes behaviors that are:

a) "observable", i.e. verbalized in terms of "what the person did;
b) "modifiable", i.e. which concern spheres of action that fall under the control of the person (Comoglio, 2000, pp. 183-190).

[1] In this regard, it is worth underlining that, based on the model in question, all linguistic formulations that express emotions using the verb "to be!" declined in the second person singular (or even plural) of the present indicative, should be considered as ineffective expressions.

In this sense, the expression "it bothers me that you are unreliable" does not fulfill these criteria, because, although it contains the self-presentation and the referential index, it qualifies the latter in terms of unreliability, that is, through a linguistic label. which does not observably specify the behavior; on the contrary, the expression "it bothers me that you are late" fulfills the criterion in question, because it verbalizes the referential index not only in observable terms (what the other has done), but also in "modifiable" terms (i.e. as a behavior - delay - that falls under the person's power of control).

finally, effective emotional communication requires avoiding, in the linguistic formulation of experiences, words such as "always" or "never" or similar expressions ("you are *always* the usual latecomer; *as usual*, I can *never* trust you"); they, in fact, decentres the communicative focus from the behavior, acts as an element of delegitimization of the identity, and (for these reasons) weakens the expressive effectiveness of the statement.

In order to make the matter clearer, the previous table 1 is reported below, with the addition of expressions referring to the specific typologies of each cell.

	Emotion	
	Positive	**Negative**
Effective	*I feel comforted by your words* *I'm happy with the good grades you achieved*	*Your behavior disappoints me* *Your behavior embarrasses me*
Not Effective	*You're very good* *You're generous*	*You're dishonest* *You're the usual careless person*

Table 2: Examples of the different types of emotional expression

2. Artificial intelligence and emotional intelligence

Among the skills that support emotional intelligence, the ability to recognize emotions plays a role of fundamental importance.

In general terms, it is possible to state that the exercise of this disposition implies a complex dynamism, which cannot be resolved into the simple structural components of the statements or the semantic declinantion of the experience.

At the level of verbal recognition, in fact, understanding emotions (knowing how to recognize them) means being able to identify the "plus" of meaning that transcends the simple linguistic articulation of the statement (Austin, 2019; Benjamin, 2019; Boella, 2010, 2018; Buber, 2011; Goleman, 2011, Piccinno, 2009, pp. 45-89; 2019; 2023; Scheler, 2011).

The focusing of the experience, in fact, requires the ability to grasp the excess of meaning certainly mediated by the structure of the statement, but which, equally certainly, cannot be resolved within the perimeter of its dynamisms.

As we noted in the previous paragraph, the excess of meaning implicit in emotional communication is entrusted to the fulfillment of some structural elements, which allow us to identify not only whether the emotion is positive or negative, but also whether it (in addition to this) is expressed effectively or ineffectively.

In the domain of artificial intelligence, the question that emerges in this regard is whether this form of knowledge is able to recognize this additional level of complexity.

The reflection around this question constituted the object of this research, during which a Machine Learning algorithm was trained in the ability to recognize not only whether emotional expressions were positive or negative, but also whether they were expressed in effective or ineffective form.

The entire process took place on a dataset consisting of 500 verbal emotional expressions and each of them was classified into one of the following categories:

a) speech forms that communicate a positive emotion effectively

b) speech forms that communicate a positive emotion ineffectively

c) speech forms that communicate a negative emotion effectively

d) speech forms that communicate a negative emotion ineffectively

The group of expressions labeled “Neutral” was added to train the system in the ability to discriminate emotional from non-emotional wording. The data set was divided as follows: 70% of the expressions were assigned to the training

procedures, while the remaining 30% were assigned to the test procedures; furthermore, the sentences were randomly distributed within these distributions.

At the end of the training, some emotional expressions not contained in the original data set were entered into the system, with the aim of verifying the relative ability of the trained system to classify them into one of the five previous categories.

With respect to this task, the system produced the results that are described below:

The system was able to correctly recognize expressions built on the "self-presentation-referential index" sequence (for example: "I'm annoyed by the fact that you speak out loud"); In particular, the system demonstrated this ability both in the case of expressions relating to positive emotions and in the case of expressions relating to negative emotions.

The algorithm, however, detected difficulties in managing the classification tasks, in cases of more complex formulations.

A first level of difficulty manifests itself in the recognition of expressions that invert (or do not respect) the previous order, as happens, for example, in statements organized on the sequence "referential index-self-presentation (For example: "The fact that you're wearing earphones while I'm talking to you bothers me."). Furthermore, this criticality is accentuated in cases in which words or phrases such as "always", "never", "as usual", etc. appear in the expressions, the specificities of which are not detected by the algorithm.

This means, for example, that the algorithm recognizes the phrase "I'm annoyed because when I talk to you you always wear earphones" as an effective negative formulation which, although containing the self-presentation and the referential index, should be classified as a negative expression ineffective, due to the word “always” contained within it.

A further difficulty is found in cases of ineffective formulations of the referential index, as, for example, in the sentence "it bothers me that you are superficial". In this case, the algorithm codes the statement as an "effective negative expression", even if it does not formulate the referential index as an "observable and "modifiable" behavior.

These data, which, at the state of this research, must be considered "provisional", nevertheless allow some summary considerations.

The comparison between correct formulations and incorrect formulations seems to confirm the hypothesis that artificial intelligence is a substantially "syntactic" system, but that it is unable to access contents of a "semantic" nature.

The system, in fact, manages to correctly encode the expressions when they reflect a given sequence (self-presentation-referential index), but does not recognizes them, according to the reference model, when they take on formulations that require a reference to the "content" of the communication.

In all these cases, the meaning of the statement is related to that "plus" of meaning that transcends simple formal sequentiality and requires reference to something "observable" that is located in space and time.

The difficulties highlighted by this investigation call for reflection on the processes that govern the development of models developed by linguistic intelligence.

The analysis of linguistic constructs is managed by these systems through particular functions, such as, for example, the "vectorization" of sentences. In fact, in order to operate, algorithms need to transform linguistic signs into numerical symbols, in order to allow the analysis of words and the relationships between them.

The question that emerges in this regard is whether the critical issues highlighted in the previous pages can be ascribed to the inability of the numerical code to represent the excess of meaning inherent in emotional expressions.

In any case, the results, albeit provisional, revealed by this investigation, seem to confirm the profile of the problems relating to the relationship between emotions and artificial intelligence, as well as the difficulty in saying a definitive word on this fascinating and controversial relationship.

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