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### Double Blind Peer Review

### Citazione

De Feo A., (2023) Cognitive and emotional processes to deal with disorienting dilemmas, *Giornale Italiano di Educazione alla Salute, Sport e Didattica Inclusiva - Italian Journal of Health Education, Sports and Inclusive Didactics*. Anno 7, V 2. Supplemento Edizioni Universitarie Romane

### Doi:

[https://doi.org/10.32043/gsd.v7i2\\_sup.950](https://doi.org/10.32043/gsd.v7i2_sup.950)

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[gsdjournal.it](http://gsdjournal.it)

ISSN: 2532-3296

ISBN: 978-88-6022-479-8

### ABSTRACT

The influence of environmental cognitive-emotional stimuli on the development of the mind-brain raises significant implications for methodologies, educational practices, and learning approaches. These implications are necessary for transforming individual perspectives and restructuring the cognitive schema of reality. In contemporary society, these cognitive schemas often become quickly outdated and inadequate for addressing disorienting dilemmas (Mezirow, 1978).

Concrete experiences that are spatially and temporally defined, internalised, and well-considered can be transformed into occasions for reflection, maturation, and the discovery of innovative solutions to complex problems. Neural plasticity permits the modification and interconnection of nerve circuits in response to experiences that transform the behaviour of individuals, causing them to acquire new skills and alter their action strategies. In light of the findings of neuroscience, this paper seeks to identify educational practices in the field of adult education that, rather than pandering to standardised and standardising market logics, enhance the complex uniqueness of the individual in the situation, thereby fostering the development of transformative learning.

L'impatto degli stimoli emotivi cognitivi e ambientali sullo sviluppo della mente-cervello induce importanti considerazioni circa le metodologie, le prassi educative e gli approcci all'apprendimento da adottare per trasformare le prospettive di significato individuali e *ristrutturare* gli schemi conoscitivi del reale che si rivelano inadatti ad *affrontare dilemmi disorientanti* (Mezirow, 1978).

La *plasticità neurale* consente ai circuiti nervosi di modificarsi e di connettersi sulla base di esperienze che trasformano il comportamento degli individui. Alla luce delle scoperte neuroscientifiche, il presente contributo vuole individuare, nell'ambito dell'educazione degli adulti, prassi educative che valorizzino l'unicità complessa della persona *in situazione* e stimolino lo sviluppo dell'apprendimento trasformativo.

### KEYWORDS

neuroscience, adult learning, neural plasticity,  
neuroscienze, adult learning, plasticità neurale,

Received 20/08/2023

Accepted 26/09/2023

Published 26/09/2023

## Introduction

Brain plasticity is the most important discovery in neuroscience (Kandel, 2007); the constant reorganisation of brain circuits and the concept that new neurons can be born in an adult brain demonstrate the adaptability of the human brain, the significance of external stimuli in relation to its development and evolution, and “the individual's continuing willingness to learn” (Frauenfelder, 2018, p.6). New experiences encourage the brain to adapt to environmental stimuli by reconfiguring the neural network, resulting in an increase in network complexity. Therefore, there is a connection between experiences, learning, and the development of the neural network.

During childhood, caring relationships, tactile and motor experiences, occasions and modes of interaction with peers, adults, and diverse environments have a significant impact on neural development and learning. The activation of synapses by experiences during the *critical period* prevents their elimination during adolescence (*synaptic pruning*). Changes in behaviour in response to experiences occur throughout an individual's life, even if the organism's response to such experiences is more pronounced during certain periods, such as childhood.

Continuous is the process of learning, which consists of the subject's reworking of environmental and cultural stimuli. An environment lacking in stimuli limits learning. However, it is necessary to emphasise that experience and learning are not synonymous, as not all experiences possess cognitive significance.

An experience is only valid if it leads to the perception of connections or successions and if it is cumulative or meaningful (Fraunfelder, 2018, p.7).

Understanding how the brain functions enables the selection of educational and didactic strategies that promote the growth of learning and the comprehension of why certain methodologies are more effective than others in enhancing training processes (Sabitzer, 2011).

In order to circumvent the risk of reductionism, the pedagogical and neuroscientific spheres are interwoven in order to frame, from two distinct epistemological perspectives, the conditions and variables that characterise human learning processes. The concept of *neural plasticity* recognises the role of culture in the evolutionary process of the human brain.

Long a defining feature of Western culture, the opposition between the sciences of the spirit and nature has been overcome by neuroscience, which asserts that both the genetic inheritance and the culture in which humans live determine their essence. The reference focuses specifically on emotions, feelings, experiences, and behaviour that are influenced by both genetic and environmental factors (Maffei, 2013).

Actually, no two brains are identical. This fact can be justified by both genetic

and functional reasons [...]. However, this justification can also be supported by the concept of brain plasticity, which refers to the brain's ability to reorganise its synaptic connections in response to internal and external stimuli.

Each individual possesses unique experiences and personal histories, engages in readings that others may not have encountered, and internalises values that are influenced by their specific society and culture (Rivoltella, 2012, p.72).

The interconnectedness of the brain's various regions also explains why rationality and emotion are not two opposing domains, but rather interact in decision-making processes. In fact, research conducted by neuroscientist Damasio (1995) demonstrates that the inability to experience emotions and feelings impairs an individual's rationality and cognitive and decision-making skills. Mind, brain, and body are realities that are closely related. According to Damasio, *Descartes' error* has influenced the development of Western medicine

in such a way that the psychological consequences of illnesses of the body in the strictest sense (so-called 'real' illnesses) are typically overlooked and, if at all, considered later. Even less studied are the reverse phenomena, i.e. the somatic effects of psychological conflicts (Damasio, 1995, p. 340).

"Neuroeducation is a transdisciplinary field of research and intervention" (Rivoltella, 2012, p.42) concerned with the conditions under which learning occurs, learning environments, disciplinary content, and the structure of educational institutions.

The underlying premise of this argument is that "the human mind is rooted in a complex and delicate organism" (Damasio, 1995, p.340). Therefore, it is necessary to acknowledge the role of the body and its neurophysiological foundation in facilitating cognitive and learning processes.

According to Damasio's (1995) *somatic marker* hypothesis, the decision-making process derives from the processing of stimuli from the entire body and not from a rational calculation of risks and benefits. The somatic marker accompanies the decision-making process with pleasant or unpleasant sensations that predict the decision's outcome. It is a warning signal that allows individuals to 'feel' the decision that must be made or rejected.

Assume you are asked to decide whether to accept or reject an extremely risky investment that has the potential to yield an unusually high return. You are asked to approve or reject it in a very short amount of time while being distracted by other issues of a similar nature. If the thought of proceeding with such an investment is accompanied by a negative somatic state, it will likely lead to the rejection of the investment and prompt a more thorough examination of its potential adverse outcomes. The negative state associated with the future counterbalances the alluring prospect of a high and immediate return (Damasio,

1995, p. 246).

## **2. Transformative learning and the *construction of emotions***

In the field of adult education, Jack Mezirow's theory of transformative learning emerged in the late 1990s. Its purpose is to explain the change in individuals' perspectives of meaning that can occur when they are confronted with disorienting dilemmas that cannot be resolved with their existing knowledge and experience, necessitating a reorganisation of their cognitive schemata. The methodological proposal of Mezirow is framed by a vision of adulthood in cognitive evolution consistent with the concept of lifelong learning (Chiosso, 2009) and the theory of cerebral plasticity. *Perspectives of meaning*

are patterns of expectations that filter perception and cognition [...], perceptual and conceptual codes that form, limit, and distort our thinking, believing, and feeling as well as the how, what, and why of our learning (Mezirow, 2003, p. 40). These are unknowingly and unconsciously assimilated through the process of socialisation. This occurs in childhood and guides the adult's perception of reality until he or she encounters disorienting dilemmas that reveal their ineffectiveness in dealing with problematic situations by calling into question the assumptions on which they are based and whose roots lie in one's cultural traditions and life contexts in which one grew up.

The transformative learning process, which is characteristic of adult learning, highlights critical reflection as an essential component.

Reflection is a conscious process of evaluation, of revisiting assumptions, even distorted ones, that occurs through the negotiation of meanings and their analytical and synthetic elaboration (Mezirow, 2003, p. 11).

Changing perspective through self-reflection and autonomous reasoning to address personal and professional challenges creates new opportunities for the development of innovative and creative solutions, particularly in areas where technical rationality provides little assistance in addressing complex problem situations. The Genevan pedagogue Necker (1936) uses the metaphor of life as a *journey* to refer to the concept that people's development occurs throughout all stages of life and is to be understood as an improvement journey that includes old age.

The theory of transformative learning, which incorporates Freire's (1971) concept of liberation from oppression, represents an important reference within the field of adult learning and teaching processes. It serves to address and manage unexpected and sudden changes within work environments, transforming moments of challenge and crisis into occasions for personal, professional, and societal development, advancement, and innovation.

However, it should be noted that Mezirow's theory, which is predicated on critical reflection, a predominantly rational process, gives little weight to feelings and emotions (Taylor, 2001), which, according to neuroscience, play a crucial role in decision-making and learning processes. Studies conducted by the Portuguese neuroscientist Damasio (1995) indicate that emotions and reason are interconnected and work in tandem. Taylor (2001, p. 223) argues that "without emotions, rationality cannot work."

The theory of the predictive brain, which originated in the field of neuroscience, considers that the human brain is constantly processing experiences to make predictions about what might occur, then comparing these predictions with what is actually occurring and refining them. The predictive machine brain envisions the future in order to better prepare humans for action and communication. The theory demonstrates that perceptions are an active process in which information is processed by interaction and comparison with what the brain has stored in memory. The same perception (image, sound, etc.) processed by two different people can give rise to different information depending on context, personality as well as life experiences. The predictive brain theory is applicable to emotions as well.

In fact, the studies and research on emotions by the American psychologist and neuroscientist Barrett (2017) disprove the notion that emotions are universal in the sense that they derive from a genetic endowment, but instead consider them to be *constructed* by the brain based on interaction with the body, past experiences, and the environment: "Emotions are (our) constructions of the world, not reactions to it" (Barrett, 2017, p. 16).

Having a high *emotional granularity* (Barrett et al., 2001), i.e. the ability to express emotions in a precise and differentiated manner, allows a better understanding of the emotions of others and a higher probability of living in a condition of psycho-physical well-being.

The importance of learning to attribute new meanings to one's emotions in order to face and overcome uncertain and challenging situations through the transformation and enrichment of one's cognitive schemes of reality becomes apparent.

Empathy is a relevant prerequisite for the transformative experience because, through confrontation, dialogue, and identification with the perspectives of others, prejudices are overcome, which predisposes to critical reflection and transformation of one's own meaning schemas (Gum et al., 2011; Stevens-Long et al., 2012; Taylor, 2007; Willis, 2012). The impact of the environment can serve as a catalyst for the transformative experience. A study of a sample of HIV-positive adults demonstrates how the altering social perception of the disease as a result of the discovery of new therapies for its treatment and the participants' social interaction with support groups contribute to the transformation of meaning in terms of how the disease is experienced and the future is planned

(Courtenay et al., 1998).

The discoveries of neuroscience concerning the synergistic influence of emotions and reason in decision-making processes lead one to consider the application of transformative learning theory to emotions as a valid tool for comprehending the mechanisms that regulate the motivation of the adult population to transform cognitive schemas of reality. Adapting them to the requirements of a society in which "change is the only permanent thing and uncertainty the only certainty" (Bauman, 2011, p.8).

The dialectic between *change* and *persistence* that characterises the *human form* necessitates consideration when designing adult education pathways that incorporate neuroscience findings and Mezirow's *transformative learning theory* to foster lifelong learning.

### **3. From the incompleteness of human form to pedagogical transformativity**

#### *The human form*

is never fully realised and therefore subject to change, endowed with its own plasticity, but retaining unaltered what we might call its nature and essence, a form that functions as a *point of resistance* in relation to internal and external stresses. It is formed and we are formed from something given - and thus permanent - the *forma hominis*, which is the original form. But what we become as individual forms occurs over time and in the process of becoming (Fadda, 2018, p.80).

The concept of *becoming*, represented by the dense web of relationships, experiences, and actions that transform into *form* and imprint uniqueness on the *single form*, is a component of the formation process that concludes with the development of *pre-existing potentialities* (Kobau, 1995). *Bildung* encompasses the dual objectives of adapting to an external framework and revealing and altering the potential of the individual to be formed. In addition to requiring a process of *conformation*, the acquisition of language, for instance, lays the groundwork for the development of a person's unique essence.

Authentic formation entails a process by which the formative material, which, according to Gadamer (1983), is a means and not an end is internalised, or incorporated into the form.

The essence of all learning is not the accumulation of correct knowledge or the development of useful skills, but rather the ability to use what has been learned as a basis for further learning (Luhmann & Schorr, 1988, p.95).

There is a *core of permanence* that defines the uniqueness of individuals and, while external experiences transform them, preserves and cherishes their essence. Therefore, educational action entails transformation based on the

aptitudes, tendencies, and inclinations of individuals, not through the application of standardised programmes aimed at the acquisition of technical rationality.

Therefore, the good educator must not ignore that *essential form* that is not rigid but stretches towards its goal, towards its possible being; and if one is a good educator, far from abandoning one's student to the random changes he may undergo or, on the other hand, far from merely applying rules and imposing predetermined programmes on him, one must try to sense the direction in which that form moves him and know how to wait where he himself does not know he should go (Fadda, 2018, p. 95).

The authentic education referred to for its problematizing nature contrasts with the uncritical notionism of *banking education* condemned by Freire (1992), whose educational proposal emphasises the importance of dialogue, confrontation between educator and educand, and the motivational drive to learn that the educator must provide the educand.

Problematizing education is based on creativity, which stimulates authentic action and reflection on reality, thereby responding to the vocation of men who only become authentic through creative research and transformation (Freire, 1971, p.92).

In today's knowledge-based society, educational institutions risk being transformed into businesses, students into human resources, and knowledge into an instrument at the service of a labour market driven by technical rationality.

Certainly, these conditions are not conducive to human development and the enhancement of subjects' critical capacities; rather, they represent dehumanising forces that permeate the entire society and push it towards individualistic and competitive models.

The application of transformative learning theory in adult education can instead respond more inclusively and democratically to the knowledge- and innovation-centered needs of contemporary society.

Work experience becomes the object of thought, producing consciously critical training on professional action and the development of a competence capable of promoting the participatory, collaborative, and co-constructive change/innovation processes required by the professional world (Ferro Allodola, 2020). Communities of reflective practice create caring relationships centred on active listening, experiences of reflective dialogue, and confrontation among participants whose different affiliations (social, linguistic, cultural, and professional) stimulate critical reflection at the origin of *pedagogical transformativity* due to their collaborative nature, as adults learn more

meaningfully from lived experiences (Mezirow, 2003).

The primary objective of this programme is to impart the skills of critical thinking, deductive reasoning, and independent reflection to both men and women who are participating in training programmes or who are facing challenging situations commonly encountered by adults (Demetrio, 2003, p. VII).

#### **4. Concluding remarks**

The findings in the field of neuroscience regarding the replicability of neurons in adult individuals (Moreno-Jiménez et al., 2019) and the plasticity of the human brain have significant implications for adult education. Particularly, these discoveries are linked to Erikson's psychosocial theory of learning, which posits that personality development occurs throughout a person's life and is influenced by moments of crisis. Adult education ought to promote pedagogically-oriented changes in the personal and professional lives of adults, especially during biographical transitions.

Pedagogical change is a longer or shorter period of time from which one emerges with a different self-perception. It is a modest laboratory where the subject, through his own initiative or through the intervention of others, discovers what he is [still] capable of (Demetrio, 1990, p.81).

The application of Mezirow's transformative learning theory to adult education through the construction of communities of reflective practises and cognitive guidance of emotions can prove useful in supporting "reinterpretation of the processes and content of subjects' professional experience" (Ferro Allodola, 2020) and make a significant contribution to the personal and social well-being of adults.

In this regard, effective tools are narrative practises. The use of autobiographical narratives, narrative diaries, and graphic representations of life and work experiences can prove to be effective in stimulating the transformation of meaning perspectives. To promote active and oriented ageing, it would be desirable to extend the main educational paths conducted in Italy regarding the implementation of transformative methodologies to the population going through the transition from work to retirement.

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