Metacognition and Colours for Inclusion: results of an explorative activity in a simplexity approach

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ABSTRACT

Schools and teachers are called upon, in the age of complexity, to deal with a plurality of problems related to the many stimuli arising from the personal and environmental influences of students. Complexity requires teachers to be in constant training and updating, to be able to propose flexible and adaptable teaching paths for the individual learner. This type of action implies a change of perspective in the way of working, leading to the stimulation of lateral thinking, capable of generating creativity. Creativity and lateral thinking imply the activation of metacognitive mechanisms, which are useful for teachers to reflect on their actions and improve their work with students, especially from an inclusive perspective. This paper presents the results of an exploratory activity, conducted on 657 teachers in training at the university of salerno, as part of the training activities for teaching support to pupils with special educational needs. The aim was to investigate whether teachers in training can develop lateral thinking, based on suggestions derived from de bono's studies (2015a) and, specifically, his theory of "the six hats for thinking" highlighting points of agreement with the theory of simplexity proposed by berthoz (2011).

KEYWORDS: inclusion, metacognition, colours, simplexity, creativity

1. Introduction

The school, in the era of complexity, due to the presence of a plurality of stimuli, and innovations is called upon to an extremely important task, namely that of guiding pupils to deal with the difficulties inherent in the complexity itself, through educational proposals that can support the *deciphering* of all the stimuli and problems, as well as seek strategies to deal with them (Sibilio, 2020).

It follows from this premise that the role of the teacher has changed. He/she no longer has only the task of transmitting knowledge or acquiring basic skills, but rather supporting his/her learner in *interpreting* and *dealing* with complexity (Sibilio & Aiello, 2018). Didactics has taken a strong leading role in the school, representing the prerequisite for interpreting the new *reticular* function of the education system and constituting the only tool capable of declining the real educational needs of learners with the professional skills of teachers (Aiello et alii., 2016).

In this original space of educational research, the current paradigm of *simplexity* (Berthoz, 2011; Sibilio, 2012; 2013; 2017), centered on a *complex*, *systemic*, *plural*, and *transdisciplinary* vision of the educational experience, fits in. If, on the one hand, this line of research has sought to contribute to a progressive revisiting of scientific approaches and domains, considered indispensable for deciphering the complexity of the educational experience, on the other hand, it has shown itself capable of interpreting the change urged by the various legislative and regulatory interventions that have accompanied the process of school development, including those aimed at promoting the processes of inclusion of pupils with Special Educational Needs through certain training paths.

The pivot of this necessary process of change, (Pace et alii., 2021) has been the training of teachers' professional competencies, indispensable for interpreting an active and effective function in the educational experience.

A particular reminder of the significance of teacher training in didactics emerges from the *Profile of the Inclusive Teacher* drawn up by the *European Agency for Development in Special Needs Education* (2012), which, among the values necessary for teachers to exercise their profession in inclusive school environments, indicates "*Personal Professional Development*", which identifies teaching as a responsibility and not just a job (European Agency for Development in Special Needs Education, 2012, p. 16).

An initial analysis of the areas of competence, knowledge, and behavior associated with this value that the teacher should possess, outlines a perspective according to which teachers are *reflective practitioners* (Shön, 1993; Aiello, 2018) and their initial training. The teacher not only transmits knowledge but meditates during the teaching action, identifies what are the strengths and weaknesses of his or her actions, trying to find innovative and *non-linear* strategies (Sibilio & Zollo, 2016), to overcome the weakness and enhance the strength, according to an exercise that stands on the great line of *metacognition* (Flavell, 1985) and *creativity* (de Bono, 2015).

The teacher, therefore, finds his or her competence in the quality of didactic interaction, developing effective and flexible problem-solving strategies (European Agency for Development in Special Needs Education, 2012) to promote innovation and individual learning and to respond to the professional need and the functional need to cope with educational complexity.

In this sense, in a *protean reality* (Sibilio, 2013) such as the educational one, characterized by the complexity and dynamism of its contexts, by the variety and plurality of learners' needs, the logic of *creative thinking*, if declined in training experiences included in the construction of the teacher's

competences, could prove to be an interesting strategy for the resolution of problematic situations.

In this regard, it is possible to find elements of commonality with the scientific reflections of Alain Berthoz, a physiologist of perception and action, who, in his theory of *simplexity* (Berthoz, 2011), hypothesizes that the solutions devised by living organisms to decipher and cope with complexity can be considered valid and applicable to the entire class of adaptive complex systems. One of the principles of simplicity described by Berthoz is the detour, i.e., a rule that attempts to solve the problem, but in an original way, and by using, experimenting with a plurality of trajectories, perhaps even unknown ones, to achieve the resolution of the problem itself (Berthoz, 2011, p. 20).
Every training itinerary for teachers should, therefore, allow for the construction of a professional capacity for a didactic *detour*, that is, for the identification of *flexible* and *alternative* strategies to those that are frequently consolidated in practices that are too often crystallized (Sibilio, 2013). Didactically, detour responds to the need inherent in teaching to seek different ways of didactic *transposition* that offer the teacher a plurality of solutions aimed at ensuring greater control of the system (Chevallard, 1981).

The prerequisite for the detour to be used in the teaching field can be found in the subject's ability to cope with the complexity of problematic situations, drawing on metacognition exercised through the use of *creativity* (Goleman et alii., 2017), *divergent thinking* (Guilford, 1950) and *lateral thinking* (de Bono 2015; 2015a), which have shown interesting educational implications and are corroborated by a rich scientific literature. In the present study, we will precisely show the results of an exploratory survey conducted on a sample of 657 students, attending the training courses for the support qualification for Secondary School at the University of Salerno, to identify whether their actions can exercise lateral thinking, thus maturing transversally innovative metacognitive skills for problem-solving and for developing inclusive operational trajectories, using de Bono's (2015a) "*Six Hats for Thinking*" as a tool for action, in the light of Berthoz's (2011) symplex *detour*. The paper will present a first section, in which the theme of metacognition will be addressed, attempting to give it a synthetic definition and tracing its potential in didactic terms; a second section of the text will focus on the analysis of color, the element on which the six hats are based, its potential in terms of divergence and inclusion; a third part of the paper will focus on the attempt to find points of conjunction between simplexity and creativity, identifying their similarities; the last part of the paper will present the results of the exploratory study conducted.

2. Metacognition: definition and inclusive perspectives

From a purely etymological point of view, metacognition represents the *'knowledge of knowledge'*, the *'thought of thought'*. The term originates from the Greek *meta*, a prefix

meaning *'beyond'*, 'above', and *cognitio*, meaning *'to know'*[1]. Metacognition refers to a reflection that a person makes on his or her mental path during the action, to plan, adapt, verify and evaluate his or her learning path. It is developed considering three fundamental components (Lafortune, 1998):

-Metacognitive knowledge*, i.e., the subject's knowledge and beliefs about phenomena relating to cognition and may relate to people (strengths and weaknesses), tasks (difficulty or ease of the task), strategies (what, how, and when to use them).*

-*The* management of the mental activity*, i.e., the subject's ability to manage his or her thinking, in terms of planning the action, controlling it, and regulating it. This type of activity is more complex and difficult to formulate verbally, and often depends on the task and context of implementation.*

-Awareness of one's mental processes*, which enriches knowledge and influences the management of the mental activity and the execution of the subsequent task. This is of great importance in the development and learning process, and enables better verbalization, stimulating exchanges with others. It also fosters autonomy in the learner to solve the problem in different contexts, becoming autonomous in their learning.*

A metacognitive individual is a person who knows himself about his ways of learning, comparing himself with those of others, and reflecting on his knowledge about the task at hand and the relevant strategies. He/she is therefore able to learn, control, modify, verify and analyze him/herself as a learner.

To become a metacognitive individual, one goes through several stages, the first of which is when the individual begins to develop metacognitive skills can name these skills and knowledge and can complete a task. The more a person progresses over time, the more he or she becomes a metacognitive subject, able to explain why a particular learning task is easier or more difficult for him or her. He is also able to name previous experiences and specify when and how they gave him problems. He is also capable of analyzing his learning process and evaluating and adapting his ways of action. From this, it is easy for him to understand what can help him achieve learning and he will know how to adapt his learning strategies and evaluate his learning process as well. Knowledge of one's learning processes will also enable one to deal with new learning situations, improving metacognitive knowledge and achieving better management of one's mental activity. Such an individual is in the right position to build better transversal competencies (Kavousi et alii., 2020).

Flavell and other researchers in the 1970s, for whom metacognition refers to the knowledge one has of one's cognitive processes and their products. Metacognition also refers, for the author, to regulation, to active control, depending on the cognitive objects and data on which they are regulated, to

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[1] Definition taken from Treccani, available at https://www.treccani.it/enciclopedia/tag/metacognizione/ (last consultation date 20/01/2023)

achieve a concrete goal and purpose. For Flavell (1985), a metacognitive experience can occur in different situations:

- *When the situation explicitly requires it.*
- *When the cognitive situation is both new and unfamiliar.*
- *In situations where it is necessary to make inferences, exercise judgment, or in decision-making.*
- *When the individual is in difficulty while solving a problem.*

Flavell and Wellmann (1977), provide a representation of metacognition, understood as the ability to process information. This capacity involves:

- *Personal* attributes *(self-assessment of one's abilities).*
- *Task* characteristics.
- Strategies *that can be used to deal with it.*
- Conditions *under which the task is to be performed (execution time, level of difficulty, the environmental situation...).*

According to Cornoldi (1999), two central elements make up metacognition:

- Basic metacognitive knowledge*: reflections about one's cognitive activity, the tendency to recognize the possibilities of its use and extension.*
- *Basic metacognitive knowledge is activated even in the absence of a* specific task*.*

John G. Borkowski (1996) emphasizes that metacognitive strategies consist of one or more cognitive operations underlying and above the processes that constitute task performance. Strategies are directed at cognitive outcomes (e.g., memorization) and are potentially conscious and *controllable* activities. They fulfill a fundamental function: they help the subject engaged in a task or activity to introduce a whole series of cognitive operations that are essential for the achievement of internalized, effective learning.

Wanting to try to draw a connection point with inclusive education, it should be emphasized that metacognition operates directly on other factors, such as *motivation*, *self-efficacy* (Bandura, 2000), the sense of *security* in tackling a task in the awareness of possessing an action and operational potential, which represent cornerstones for inclusive education (d'Alonzo; 2018; 2019). Sharon J. Derry (1992), Pressley (1990), De Beni, and Pazzaglia (1983) have highlighted the fundamental role that personal, motivational and self-esteem components play in the development of metacognitive skills. Specifically, how *intrinsic*, and *extrinsic* motivation (Weber, 2003), and self-esteem in terms of personal abilities and potential (Stirling, 2014), are foundational elements to work in the direction of *Full Inclusion*, already widespread with the Salamanca Conference (UNESCO, 1994).

Good didactics focused on the development of metacognitive processes that require intervention on four levels. The first level can be *knowledge of metacognitive functioning*, i.e. the study of those theories that underlie metacognition, the

actions taken in didactics, and the educational successes achieved through a metacognitive approach; *self-awareness of one's cognitive functioning,* i.e. knowledge about one's own reflective and action mechanisms, derived from the study itself resulting from the theories; generalized use of metacognitive regulation strategies, i.e. awareness of the existence of mechanisms capable of regulating one's impulses, enabling us to act rationally before the problem, finding effective solutions from time to time to resolve it; underlying psychological variables, i.e. awareness that when we operate in a metacognitive sense, we may also encounter sudden changes, difficulties that make operational and, specifically, didactic action much more complex (Borkowski & Muthukrishna. 2011). Often it is the possibility of working scholastically with a plurality of actors, of people, characterized by a twofold level of complexity, indeed *internal*, thus deriving from the changes that the human being undergoes from a biological point of view, and which are linked to factors such as age, sex, auxological evolution; *external* complexity, deriving from the phenomena that affect the student's effectiveness, his or her level of participation in school, such as family conditions, influences of educators, teachers, babysitters, which represent systems in their own right, in turn, characterized by peculiarities and influences, capable of conditioning the systems with which they interact, modifying the structure and organization of the macrosystem (Sibilio, 2020). The result is, therefore, an advantage of the application of metacognitive didactics in the classroom and, specifically, on the child, which can be summarised in a few key points (d'Alonzo, Bocci & Pinnelli, 2015). Metacognitive teaching emphasizes the development of *flexibility*, *divergent thinking*, continuous *self-monitoring of actions* and *thinking*, encourages the *objective analysis of problem situations* and the collection of data, stimulates the use of *strategic thinking*, fosters awareness *of oneself and one's abilities*, is realized through didactic *mediation* (Rossi, 2016), and *values differences*. It is precisely this aspect that is of importance, since the metacognitive intervention, by stimulating awareness of one's processes and the recognition of differences with the other from oneself to the potential inherent in the different, as a metacognitive system capable of operating and having characteristics that differ from those of others, possesses a *unique potential*. Recognition of this potential is the manifestation of an inclusive process of valuing diversity.

Therefore, space should be given in school curricula to the concrete application of metacognitive strategies to support students, particularly those with Special Educational Needs, in understanding their potential, for the realization of contexts of openness, recognition of the specificities of each, acceptance of their own and others' *limits* and *potentialities*. Metacognitive strategies mean, in fact, the implementation of didactic paths to foster the acquisition of knowledge, skills, and competencies, supporting learners in organizing information, reducing its *complexity*, and linking it to what they have mastered.

They are applicable in all curricular paths and facilitate the effective use of personal cognitive resources and reflection

on the procedures implemented and their usefulness. They are applicable on three levels: there are *central strategies*, focusing on the learner's disposition towards tasks, interconnected with motivational factors; *macro-strategies*, linked to metacognitive control processes such as monitoring, checking, reviewing, self-assessment; *micro-strategies*, focusing on more specific tasks, such as asking questions or planning actions on a particularly well-defined domain. The choice of good metacognitive strategies in the educational field, to foster inclusion, can contribute to the maturation in children of skills such as writing, reading, mathematical-scientific knowledge, text comprehension, language production, and learning of historical-geographical disciplines. Fedeli (2012), summarises the inclusive potential of the application of metacognitive education, outlining a systemic view of it, like the *ecological model* proposed by Bronfenbrenner (1992). From a *macro-systemic perspective*, it recognizes how metacognitive is a system suited to fostering human relationships within certain contexts, and how it can cultivate humanity through the recognition of the other; in a *meso-systemic vision*, a metacognitive approach becomes a promoter of attitudes, conducts, able to operate on the individual child's motivation, as well as recognizing and respecting the different cognitive styles, the different multiple intelligences (Gardner, 1987), favoring self-efficacy and self-esteem processes; in a *micro-systemic* perspective, it becomes able to enhance the development of short and long-term memory, working memory, generating positive results in terms of performance, attention. Therefore, if we want to sum up the importance of metacognition and its application for inclusive teaching, we must, first of all, recognize that it works to promote knowledge of the self in its entirety, as a being with potential and limits; it also becomes, in this sense, a tool for maturing the recognition of the other as a being with unique and different potentialities and peculiarities, according to a vision of valuing differences rather than discrimination; it becomes, finally, a means for the development of creativity, non-linearity, divergent thinking, in that it allows one to regulate one's mechanisms, allows one to find alternative solutions to problems, even following roads not yet traveled but which may be equally effective in reaching one's own goals. The result is that recourse to art, in its entirety, could be a good trajectory to foster both metacognition and inclusion.

3. A color to diverge, a color to include!

The first theory on the concept of divergent thinking dates back to the American psychologist Guilford who, in an article entitled *Creativity* (1950) in the *American Psychologist*, identifies divergent thinking that is less bound to rigid and rational schemes, open to new solutions and capable of giving rise to a new associative mode of elements to achieve objectives, placing it alongside the convergent thinking that had characterized scientific research up to that time.

According to the scholar's perspective, therefore, convergent thinking operates within established schemes, tackles the problem with a given method, and, through the latter, finds the only possible solution; *divergent thinking*, on the other hand,

acts outside the established schemes, allows one to approach the problem with a new approach, arriving at original solutions and identifying the creative process with the typical dynamics of *problem-solving* (Zollo, Kourkoutas & Sibilio, 2015).

Guilford (1967), in analyzing and evaluating divergent thinking skills and abilities, identifies four fundamental factors:

-Fluency and quickness of thought (ease in responding to a given problem with many ideas and rich, fluid language).
-Flexibility and ideational ease (abandoning usual patterns of thought and responding with ideas from various categories).
-Originality (offering answers that are unusual, rare, and difficult to point out in intricate situations).
-Elaboration (ability to add detail to the first answer given by enriching it and making it complex). Divergent thinking, therefore, is expressed not only in the search for exact solutions within the multiplicity, in the plurality and originality of the answers provided, and in the multiplicity of ideas; in this sense (Yasin & Yunus, 2014).

Creativity is an exclusive characteristic of a few exceptional minds and becomes the hallmark of human thought, the natural expression of the individual's inner self.

According to the perspective of scientific and psychological research, creativity enables human beings to adapt and seek new solutions to the most varied problems; it can be understood as a means of a detour from stereotyped and modeled problem-solving actions in that, by overcoming organized reality, it can unhinge opinions and beliefs and provide a new perspective (Cesa-Bianchi et alii., 2009).

This conception prevails in many scholars, including Daniel Goleman, who, believing that the creative spirit is within the reach of anyone who feels driven to try and improve things, of anyone who wants to explore new possibilities, understands creativity as a capacity for improvement and adaptation (Goleman et alii., 2017), as well as a means of identification with the other from oneself, as a way of recognizing *inter*-individuality through a process of *intra*-individual maturation. This process links creativity to metacognition, as a good metacognitive process focused on creativity can become a factor in the identification of the other than oneself and one's full potential.

A further theorist, who made creativity the cornerstone of human action, was de Bono (2015). the Maltese psychologist and physician applying *creativity* to the business world and linking it to corporate competitiveness define it as "*the capacity to think and act differently that can be developed systematically and deliberately by anyone who wants to put the principles of lateral thinking into practice*" (de Bono, 2015, p. 28). An application of creativity for the development of problem-solving skills and, transversally, the maturation of metacognitive skills, is given by "*The Six Hats for Thinking*" (de Bono, 2015a).

The scholar, through the metaphor of hats, teaches how to approach problems by assuming different points of view and

proposes six different perspectives from which an idea can be generated. This premise is useful to understand how through the *creative* and *divergent process* one can also produce results in the recognition of the other from oneself, in the awareness that the hat worn by the other from oneself represents his/her mode of expression, his/her value to be recognized, accepted, and supported, in a properly inclusive vision.

Edward de Bono's reflection starts from the way we approach problematic situations, in many cases considering only one point of view and thus reducing the possible solutions. According to the scholar, each way of solving a problem situation can be compared to a hat that not only defines a certain type of thinking but also has its color (de Bono, 2015a); therefore, instead of trying to cover all aspects with thinking, it is possible to separate the various types of thinking and carry them out separately:

- The white hat is about pure facts, figures, data, and information and reflects vertical thinking. The thinker wearing a white hat enunciates neutral statements; he puts simple ingredients on the table. White (absence of color) signifies neutrality.

-The red hat provides the emotional point of view: not only emotions and feelings but also presentiments and intuitions; the red hat is the exact opposite of the white hat, which is neutral, objective, and detached. Emotions influence thinking because there is first a strong emotional charge in the thinking subject; emotion is triggered by perception or sensation, leading to every decision to be made based on a value judgment. The thinker in the red hat is entitled to say, this is my feeling about the problem'.

-The black hat relates to the negative aspects and reasons why something cannot work; whereas with the red hat, we are not required to rationally justify a feeling, with the black hat we must provide logical and relevant reasons. The task of the thinker in the black hat is not to raise doubts, but to point out weaknesses objectively, to point out risks, dangers, flaws, and problems that might arise.

-The yellow hat encompasses optimism, hope, positive thoughts, and opportunities. The yellow hat can be defined as 'conjectural-positive' because it involves curiosity, ideation, and implementation. Positive evaluation does not arise from the perception of an advantage but precedes it. The yellow hat is the exact opposite of the black hat. Thinking with the yellow hat is positive and constructive as yellow symbolizes sunshine and optimism.

-The green hat indicates creativity, and the generation of new ideas and is typical of lateral thinking. Green is the color of fertility, of growth, of plants developing small seeds, and it is the hat that symbolizes lateral thinking, and creativity. Thinking with a green that means abandoning old ideas to find better ones.

Judgment is abandoned in favor of the movement. Movement is an active term. An idea is chosen for its ability to move, for its propulsive effect.

-The blue hat is related to the control and organization of thought; it is therefore also related to the use of other hats. Since blue is the color of the sky, which dominates everything, the thinker who wears such a hat organizes thought itself. The blue hat is responsible for enforcing the rules, it is like an orchestra conductor.

From this brief description, it follows that the "*Six Hats for Thinking*" constitute "*a tangible tool for translating intention into implementation*" (de Bono, 2015a, p. 23) and, starting from the assumption that if one plays the part of the thinker one eventually becomes one, they consider intention as the first step towards solving a problem; this is followed by the moment of implementation: "*thought adapts to gesture and fiction becomes reality*" (de Bono, 2015a, p. 20).

The color that distinguishes hats represents a much broader mode of expression; it takes on a symbolic significance. It becomes, in fact, a means of guiding the individual to activate mechanisms of perception of diversity, of different ways of facing reality, using color as an *interpretative key*, as a tool for accepting the different way of looking at the world, as a different method of valuing diversity, adapting to a thought that is not lateral, but inclusive, respectful of all and each one. Von Goethe himself considered color as the actions of light capable of expressing *passions* and *actions* (Von Goethe, 1970). Color, therefore, is a representation of oneself that only finds meaning in the relationship with the other, in the awareness that with the other the total process of recognition of belonging to nature is realized. Color, therefore, expresses the sensitivity of the individual, and strong feelings, both positive and negative, capable of providing insight into us and others (Carluccio, 2008). Kandinsky himself in "*The Spiritual of Art*" (1989) explains the semanticity of color, according to which black is synonymous with despair, meaning, and the end, from which other colors unravel, a symbol of *re*-birth and continuation, the beginning of new worlds to explore. Color, therefore, is an expression of *conditions, of experiences*, of personal and shared experiences, a means of re-encountering and integrating different colors which, in the union, in each case give rise to chromatic balance.

Color and lateral thinking, therefore, seem to have points of concordance, according to the description provided by de Bono (2016), a synthesis between the subject's property and will and, therefore, which can be considered either as a state of mind or methods of expression of the same. The choice to follow lateral thinking, this original harmonization between the natural aptitude of the subject, his will to produce a change in his point of view in the recognition of the other, and his attitudes is, precisely, an expression of inclusion.

Declined in the educational field, the exercise of lateral thinking theorized by de Bono would require experiential itineraries for the construction of the teacher's professional skills, to be carried out through activities that introduce the subject's

ability to exercise *flexibility* and *detour* in didactic transposition. Such an approach recalls, therefore, the central role of awareness, i.e., the teacher's ability to recognize his or her attitudes and the methods adopted to deal with problematic situations, also by mirroring the view that others have constructed on the practices of his or her actions (Zollo, Kourkoutas & Sibilio, 2015).

Creativity, in short, as recognized by the neuroscientist Berthoz (2011), allows one to mature an additional skill, namely, *flexibility*, which enables one to see the same thing from several points of view, confront changes, and devise new solutions allowing one, above all, to practice original thinking, from a different way of approaching the problem and not looking for strategies to decipher and overcome them in a simplexity manner, but rather adapting to their complexity through original and resolving forms... *forms of simplexity coping*.

4. Creativity and simplexity: a possible connection?

From the descriptions conducted so far on the concepts of creativity, divergent thinking, and lateral thinking, interesting points of reflection emerge on possible didactic declinations of these theories in the perspective of a simplexity didactic, i.e., a teaching method capable of *deciphering* and *coping* with the complexity of training processes and educational contexts. Simplexity starts from the assumption that human organisms can *flexibly* adapt to problematic situations, using operational *patterns* and *rules* of use. Over time, there have been studies that have highlighted how simplexity applies not only to human organisms but also to other fields outside the biological, including educational as well as inclusive didactics (Sibilio, 2012; 2013; 2015; 2017; 2020; Aiello et alii., 2013; Aiello et alii., 2017) [e.g., Fig. 1 and 2].

Fig. 1 and Fig. 2 simplexity properties and rules for inclusive teaching (Aiello, Pace & Sibilio, 2021, pp. 6-7)

Definition of simplex properties (Berthoz 2012; Sibilio 2014)	Their application in inclusive contexts (see, e.g. Aiello 2017; Berthoz 2015; Di Tore 2018; Pace 2017; Pace and Aiello 2018; Pace et al. 2015; Rivoltella 2014; Sibilio 2014 for further detail)
Specialisation and modularity – Breaking down a complex task into simpler ones (specialisation) which when reassembled (modularity), lead to an intended result (e.g. different roles within a community which, with each other's contributions, make it thrive).	When presenting students with a specific task, e.g. a laboratory experiment or a research project rather than giving all the instructions at once, these could be divided into smaller guided steps, depending on the students' ability and past experience, to facilitate students in reaching the set objectives.
Speed – Making decisions by anticipating consequences of actions and predicting the behaviours of others, based on past experiences. Solutions need not be simple but have to be rapid and effective.	Quick actions often need to be taken in situations where, for example, students do not seem to be engaged in the activities proposed, there is an unexpected disruption, or a technological device or resource is suddenly unavailable. In these cases, teachers find solutions rapidly to overcome difficulty.
Reliability – The ability of reducing error to a minimum and increase success.	When teachers differentiate their teaching strategies and assessment methods to meet students' learning styles, they increase the reliability of reaching their aims with all students.
Flexibility, vicariance and adaptation to change – Choosing the right strategy from a wide spectrum of choices on the basis of the stimuli emerging from the environment and be ready to change strategy if the need arises.	Feeling confident in selecting and adopting the most appropriate pedagogical approach depending on the students' interests and inclinations. This entails being able to use a variety of teaching strategies effectively (peer tutoring, cooperative instruction, flipped classroom etc.).
Memory – Explicit, implicit, episodic, verbal, iconic and effective forms of memory; all needed to predict future outcomes on the basis of present and past situations.	Teachers can anticipate challenging students' behaviours and devise a repertoire of strategies that can limit their manifestation on the basis of their prior experience.
Generalisation – The transferral of patterns of interaction from one context or situation to another.	All the knowledge and skills acquired are capitalised to deal with emerging situations that characterise inclusive classrooms.

Definition of simplex principles (Berthoz 2012; Sibilio 2014)	Their application in inclusive contexts (see, e.g. Aiello 2017; Berthoz 2015; Di Tore 2018; Pace 2017; Pace and Aiello 2018; Pace et al. 2015; Rivoltella 2014; Sibilio 2014 for further detail)
Inhibition and the principle of refusal – When making a choice, one is refusing or inhibiting all other possible options. Unless we are aware of this, with the passage of time, these choices become automatised and we adhere to the same action-reaction patterns without stopping to consider whether other solutions could be more profitable or beneficial in similar circumstances.	To implement inclusive classroom approaches, teachers need to inhibit their routine teaching habits. Reflecting on the reasons of one's choices helps to identify the best approach one should use, even if this may require a larger effort on the teachers' part. Encouraging the search of creative solutions means inhibiting the automated solutions one is usually used to adopting.
Specialisation and selection – Living organisms perceive the world from cues important to survival, creating a subjective universe. The parsimonious selection of essential information to reach one's goals helps organisms to hypothesise and project their intentions.	Teachers need to find ways to enter their students' worlds, put themselves in their shoes and perceive the world from their point of view to identify the cues that attract their attention and maintain it over time. Stimuli proposed have to capture students' interests and the information presented needs to be carefully selected.
Cooperation and redundancy – Cooperation – Putting together information available to guarantee coherence and reliability. *Redundancy* – Duplicating components makes a system failsafe.	Topic or theme teaching is an example of cooperation where information usually taught in one subject is supported by data from other subjects. Using different forms of assessment (summative and formative; oral and written; project-based, performance-based) aids in triangulating data and increase reliability.
Probabilistic anticipation – Hypothesise on probable future results based on the information at hand in the present and one's memory of the past.	'[R]eflection and anticipation are precursors of responsible action' (OECD 2018, 6). Teachers continuously anticipate student outcomes when lesson planning, base their decisions on possible consequences, weighing out the pros and cons.
Detour – This principle refers to choosing non-linear more complex solutions to make a problem simpler to resolve.	Acknowledging that students have different learning styles entails respecting students' times, choosing longer yet more effective ways to help students acquire knowledge and skills.
Meaning – Giving meaning to our intentions to act, by establishing goals and objectives, establishes a link between the action and intention.	Setting clear objectives and sharing them with the students, authentic learning, providing occasions for students to choose their topics of interest and the creation of inter-relationships among disciplines and life experiences are all forms of meaningful learning.

If we want to connect *simplexity* with *lateral thinking* and, consequently, creativity, it is possible to identify significant analogies with lateral thinking, which can give rise to the creative process.

Among the distinctive traits of creative, divergent, lateral thinking as analyzed are *flexibility*, *reliability,* and *detour* (Guilford, 1967; Goleman et alii., 2017; Cesa-Bianchi et alii., 2009), identified by Berthoz as properties and rules of simplexity, i.e., simplexity tools and rules that enable deciphering and coping with complexity, including educational complexity.

Flexibility and *reliability* to change are configured as simplexity properties of the didactic system and didactic and inclusive action, which must "*be capable of perceiving, capturing, deciding or acting in many ways (vicariousness) depending on the context, compensating for deficits, coping with new situations*" (Berthoz, 2011, p. 9). These are, therefore, tools that allow one to disentangle oneself from the protean difficulties of the learning experience, seizing precisely from the problematic situation the opportunity to broaden knowledge through action.

In a similar vein, de Bono (2016) proposes using thought not to solve individual problems, but to grasp new interpretations of reality. The search for different adaptive solutions and alternatives to usual situations constitutes, in this sense, the expression of *freedom of choice* in the broad repertoire of possible solutions to avoid getting lost in complexity. Berthoz precisely sees this as the rule of simplexity, grafted onto the search for precisely this plurality of *original solutions to problems* (Zollo, Kourkoutas & Sibilio, 2015).

In this sense, further simplexity rules such as *inhibition*, the rule of *refusal*, and the principle of *detour* appear useful to bring out the potential of creative thinking, which precisely requires the ability to inhibit and reject automatic and immediate solutions, identifying *flexible operational strategies* that, through ancillary complexity, bring out new modes of didactic action capable of favoring the learning process. Such didactic actions are also suitable for favoring inclusive pathways,

In light of these reflections and considering the systemic perspective outlined, the acquisition of *creative thinking skills*, consistently with a simple vision of didactics, could be a valid strategy to promote training interventions aimed at deciphering complexity, favoring effective and inclusive courses of action.

5. Description of an exploratory survey: methodology

5.1. Research question and objective of the training activity

Based on the theoretical premises presented, a research investigation was carried out, initiated based on the question: *Is the teacher, both in training and working at school, able to exercise lateral thinking, which is also important for the maturation of metacognitive and creative thinking and useful for applying it during the teaching phases to guide the pupil to the development of problem-solving?* The question was therefore posed as an objective to investigate whether teachers in training, in the process of obtaining the qualification to teach support

aimed at the Secondary School, can recognize creative thinking in themselves, understood as "*the set of attitudes, expressions and techniques that allows one to transversally cut through the schemes of an asymmetrical self-organized system to generate new conceptions and perceptions*" (de Bono, 2015, p. 201) and are predisposed to use it.

5.2. Participants

The research, eminently exploratory, was conducted with a sample of 657 teachers, some undergoing initial training, others already educators and teachers in schools, belonging to four different groups, who from September 2022 to July 2023 are following as part of the Enabling Pathways on support for Secondary School at the University of Salerno, characterized by both a general and special pedagogical-methodological-didactic framework (General Didactics, Special Didactics, Special Pedagogy, Methodology, and Educational Design).

5.3. Research phases

The activity proposed to the teachers in the four training groups was divided into three phases:

In the initial phase of the qualification course, starting from the assumption that the adoption, in the teaching field, of flexible and alternative strategies can offer the teacher a plurality of solutions, as also corroborated by the scientific literature of reference, the main studies on creativity and divergent thinking were illustrated to the trainees, dwelling in detail and depth on Edward de Bono's theories regarding lateral thinking and presenting the "*Six Hats for Thinking*" method as a tool for exercising creative thinking. Alain Berthoz's theory of simplexity was subsequently explained.

The first phase, characterized above all by theoretical reflections on the subject, was followed by a practical-operational moment: the teachers already previously involved in group activities of various types, proposed an exercise aimed at exercising *lateral thinking* and, therefore, *creative thinking*, centered on the declination of the properties and rules of simplexity in general didactics, in disciplinary didactics and special didactics.

In the third phase, after providing the theoretical foundations about creativity, a series of group training experiences were carried out that, through discussion, highlighted the importance of awareness of diversity and perceptual plurality in teaching. Subsequently, teachers were asked, based on Edward de Bono's (2015a) "*Six Hats for Thinking*" method, to indicate on a pre-filled table using the integrated *Google Forms* function, the color of the hat that best described their characteristics in the problem-solving phase, specifying, through the indication of the color, the approach considered prevalent concerning the others.

6. Data analysis

The analysis of the data made it possible, first, to detect how the teachers in training within the framework of the Enabling Pathways on support for Secondary Schools have different perceptions of their approach to solving problematic situations.

Being an experience aimed at understanding the teachers' tendency to use creativity for a lateral approach to *metacognitive* and *inclusive* didactics, to overcome the rigidity of logical models linked to vertical thinking very often used, specific attention was paid to the color of the hats that fully represent the two types of thinking: *white* (vertical thinking) and *green* (lateral thinking).
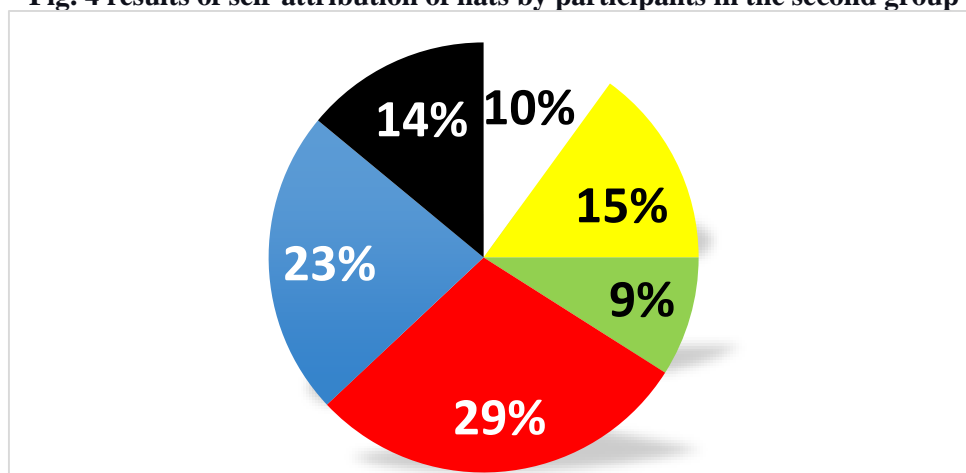
7. Results

Regarding the data from the first group (e.g., Fig 3), it should be noted that the highest prevalence was attributed to the red hat (29%), and the yellow hat (21%). The blue hat also found a good percentage of attribution (18%). The last two hats identified as their own were green (13%) and white (13%).

Fig. 3 results of self-attribution of hats by participants in the first group
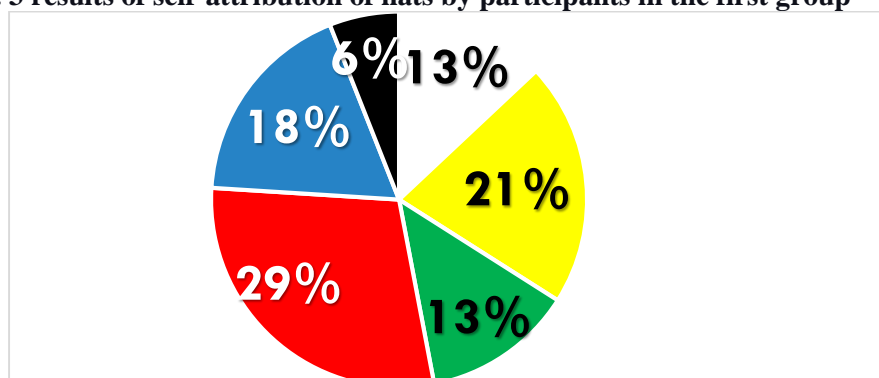
As far as the second group (e.g., Fig. 4) is concerned, a prevalence of the red hat (29%), followed by the blue hat (23%) should also be noted. An almost equal percentage emerges between the yellow (15%) and black (14%) hats. Here too, the white hat (10%) and the green hat (9%) are in the minority in terms of self-attribution compared to the others.

Fig. 4 results of self-attribution of hats by participants in the second group

As far as the results of the third group (e.g., Fig. 5) are concerned, there was again a prevalence of the red hat (25%), followed by an equal percentage of 17% of yellow and white hats. This was followed by a 17% attribution of blue hats. The lower attribution of the black (14%) and green (12%) hats, representative of lateral thinking, should be highlighted.

Fig. 5 results of self-attribution of hats by participants in the third group
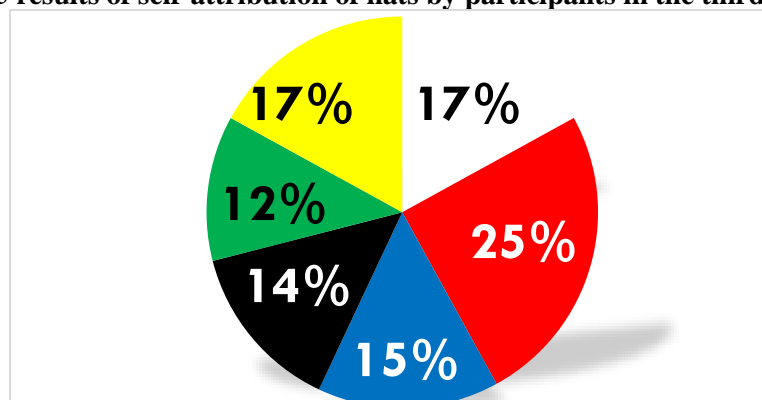
As far as the last group (e.g., Fig. 6) is concerned, it should be noted that the red hat (31%) is the predominant one, followed by the blue hat (25%). Then comes the white hat (16%), followed in the last positions by the green hat (13%), yellow (10%), and black (5%).

Fig. 6 results of self-attribution of hats by participants in the fourth group
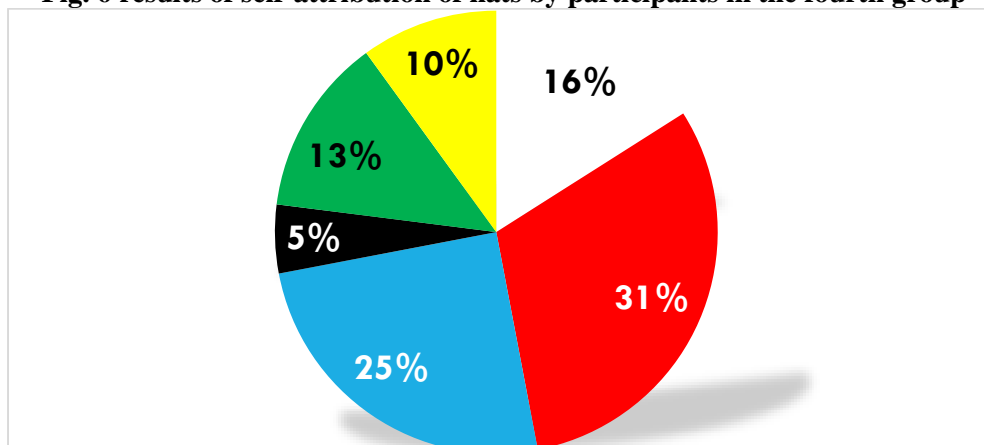
8. Discussion

From the analysis of the data, it emerges that the way of acting, and reflecting, of the teachers, is aimed at a prevalence of *emotions*, the red hat being the prevalent one in all four groups. It also emerges that the vertical thinking hat, i.e. white, does not turn out to be one of those most attributed, a sign that the teachers are attempting a change of course in the way of acting and operating, attempting to overcome a vertical tendency in the way of approaching the problem, highlighting an initial form of *non-linearity* (Sibilio & Zollo, 2016) through recourse to emotions, to positivity, also experimenting with a possible interconnection of the six hats through the organization, highlighted with the choice of the blue hat. However, the road to be taken so that the green hat, i.e., that of *lateral thinking*, is preponderant, is still uphill, as the teachers do not show, for all four groups, a general tendency to wear such a hat, which is useful for exercising creativity, while also respecting the *detour* from operational standardization. It is also to be hoped that black can increase their percentage. The hypothesis of the rejection of the black hat is its association with negativity. In truth, the black hat requires that a person, in each problematic situation, is also able to foresee weaknesses to construct suitable paths to intervene and avoid them, even then by resorting to creativity. This kind of aspect is necessary for those who, working in the world of Special Educational Needs, can identify the elements of weakness in the pupil, highlighting their strengths as a tool for building a good inclusive curriculum.

9. Conclusions

In the situation of complexity, dynamism, and plurality that characterizes today's educational contexts, the exercise of *creative thinking* could represent a valid *problem-solving strategy*. The production of new and alternative ideas, the ability to approach problems innovatively, flexibility, *and adaptation to change* and *detour* are not only peculiar characteristics of *creativity* but also fit coherently into the perspective of inclusion and in the perspective of simplified didactics.

The results of the training activity carried out with the teachers within the framework of the Enabling Pathways have, however, highlighted, through the research carried out, which was exploratory, a low predisposition on the part of the teachers to exercise creative thinking and to use *flexibility*, *adaptation to change* and *detour* in the teaching field.

In light of this scenario, starting from the awareness of the importance, in teacher training, of *creative thinking*, which, as emerges also from the *Profile of Inclusive Teachers* (2012), allows for the development of effective and flexible strategies, and due to the various cognitive styles of learners, it would be appropriate to work more on creativity (Zollo, Kourkoutas & Sibilio, 2015).

In conclusion, the results presented, on the one hand, solicit further and broader studies, on the other hand, they encourage, based on the critical issues that emerged, scientific reflection on the necessary and possible planning of specific training itineraries aimed at the acquisition, by teachers, of didactic detour skills and the identification of flexible and alternative strategies that can be capitalized on in the activity of coping with the educational complexity in the educational environment.

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