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Creativity in developmental trajectories:

transversal competencies and the promotion of psychological and

relational well-being in adolescents and young adults

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Index

FIRST PART

Preface

When I started my doctoral journey four years ago, it was clear to me what the central topic of my research would be. Excitedly, I told around that I would be working on creativity, the democratic capacity that rewards the curious and enterprising. Everyone's creativity, the daily, small creativity that goes almost unnoticed. A creativity that is in the service of ideas, change and well-being. A creativity far from geniuses and gifted students. A creativity that supports all students, including those like me. Like me, an average student who is not particularly good at anything, yet sufficiently skilled at most things. The one who is good but "can do more". A creativity that legitimizes the mistake, the attempt, the diversity of answers. A creativity that is truly transversal and cannot be limited to art, music or poetry. A creativity that rewards visionaries, those who can imagine, who think outside the box, who daydream. The creativity of children. Like that of P., a six-year-old who was born in China but has been living in Italy for a year. He drew a solar panel and explained to me how it works. "Simple, is not it?". He added and smiled at me. I believed and still believe in this creativity more than before.

I was prepared for the challenges and difficulties of the path I had chosen, but I certainly could not have imagined what 2020 had planned for us all. The pandemic upset all plans, unexpected, unwanted, unimaginable. For my research project, I had no choice but creativity. Creativity in the form of power to start from zero.

The original aim of my doctoral thesis was to conduct a literature review on creativity and, in particular, on the importance of creativity assessment in a school context. This is a popular topic in the literature, but one that remains unresolved due to the obstacles that the education system places in the way of promoting creativity. Assessing creativity allows us to know it, to monitor its development and to promote it. This is especially true when it comes to creativity in the school context. The new generations are growing up in a fluid, modern, ambiguous and complex society that demands flexibility, adaptability, critical and creative thinking, problem solving and the ability to think outside the box, possibly before others. Yet the revolutionary power of creativity continues to be ignored. People underestimate its impact on educational success, mental and physical well-being and relationships. Above all, people claim to assess the creativity of this new generation with tools from the last century, born for other students and other times. New technologies and digitization have changed every aspect of our lives, but schools, especially in Italy, still seem to be stuck in the 1980s. The weekly computer lesson elicits a bitter, almost pitiful laugh. Today's students live surrounded by smartphones, tablets, PCs, game consoles, virtual and immersive reality. The school system is truly convinced that it can still capture the curiosity of digital students. Even the way creativity is implemented in schools is outdated. It is not enough to show that it is an essential cross-curricular

skill for the students of today and tomorrow. It is not enough to show that it is possible to build creativity into the curriculum and encourage students to think outside the box, to be curious and imaginative and, above all, to be flexible. And then perhaps it might help to assess creativity and show once again that creativity is a resource that produces well-being when used in education and predicts discomfort when ignored and discouraged.

But do we really think we can evaluate them with instruments from the last century? Paper-based, unsuitable for large-scale assessments, validated on generations of young people who no longer exist?

These considerations led to my main research goal: monitoring creativity in middle school, partly through the development of a digital tool. The need to work in middle school stems from the idea of prevention, i.e. taking a series of measures to prevent a future problem. If the creative potential of adolescents and young adults is to be fostered, the work must begin in the lower grades. Fostering creativity in preadolescence helps students develop flexibility and divergence in thinking, important elements in guiding secondary school choices and redefining identity in adolescence. However, in order to adequately promote creativity in this age group, it is necessary to monitor and thus measure their development in order to also evaluate the results of the interventions carried out in school. The idea of developing a mobile app to measure creativity arose precisely to ensure a large-scale, simple and effective assessment that makes appropriate use of the new technologies used by students. An instrument that follows the paper version of the Test of Creativity and Divergent Thinking (TCD; Williams, 1993, 1994), which is widely used in the literature to assess creative potential and is considered by many to be one of the few without gaps related to cultural affiliation because it is a drawing test that is not mediated by language. At the same time, it is a novel tool that stimulates students by allowing them to draw by touch and add new indices.

But this early goal of mine was abruptly halted and overtaken by events.

In March 2020, just a week before data collection began in the Turin schools, Covid-19 had reached such proportions in Piedmont that all non-essential activities had to be suspended. The university was closed. The schools were closed. Data collection was skipped. My PhD programme came to a halt, but that was just a run-up to the new beginning.

It was an intense few months, emotionally and cognitively. Covid-19 relegated me to a 25-square-metre one-room flat alone for three months. Creativity got me out of there and restarted my project. By the end of the lockdown, my goals had changed, but creativity had become an even more important element. Distance learning, the lockdown, the vaccine rush, the "*everything will be fine*" banners, improvised recipes, video calls with the family, gymnastics in the kitchen. Creativity had become the engine of the economy, of recovery, of the school and business system. Suddenly

creativity was on everyone's lips, as it had not been since the Second World War II (at least that's what they say...).

I started from scratch with this new reality: creativity during the pandemic period.

Who actually contributed to the scientific literature by reporting on the relationship between creativity and resilience after a pandemic? What really happened to the students, especially the older ones, the university students, the ones slightly younger than me? Did creativity affect them all in the same way?

So many new questions and the desire to pursue old questions as well, like dreams that lie in the drawer because it was not time to return to the schools.

For this reason, the work I present in this dissertation summarises different moments of this doctoral journey, not necessarily in chronological order in terms of its conception.

Starting from the new pandemic situation and the psychological consequences of this period, I wanted to investigate the role of creativity as a resource in the service of well-being in a population that moves between late adolescence and emerging adulthood. I wondered if the scientific literature since the beginning of the pandemic had really focused on what was happening with young people, with studies showing the link between creativity and resilience. Then I focused on university students, the ultimate random sample during the pandemic period. Several studies almost never looked at university students in their complexity as emerging adults and highlighted the resources they had discovered during the pandemic: their creativity, resilience and social support from family and friends. But when I got carried away with the development of creativity in the post-pandemic period, the drawer where I kept my unfinished project opened again. The idea of being able to digitally assess creativity without necessarily being present seemed more of a necessity than a whim. Almost at the end of my PhD, the prototype of the app was finally tested and put into operation, albeit for a different age group than the one I had imagined four years ago.

With this introduction I wanted to recount how this work came to its present structure. The first part presents the problem that this thesis seeks to answer, the aims and a theoretical introduction in relation to creativity and its role during the Covid 19 pandemic. In the second part, three papers are presented: a literature review on creativity and resilience in adolescents and young adults during the pandemic; a cross-national study on the predictive role of creativity and social support on resilience in Italian and Spanish university students; and the development of the TCD-D app to assess divergent thinking with a sustainability study with university students. Conclusions with a consideration of implications and future prospects conclude the paper.

"Some loves don't end, they take immense turns and then return..." the words of Venditti, an Italian singer, seem best suited to describe my PhD journey. The pandemic has not completely disrupted my research plans. It may even, without knowing it, have supported them. After all, creativity is born out of chaos, uncertainty and the breaking of old equilibria, enabling us to create new ones.

Chapter 1. Problem, General Objective and Specific Objectives

This first chapter will briefly state the problem, the general aim and the specific objectives of the thesis.

1.1. Problem

The history of creativity is as old as the history of mankind, and yet we never tyre of talking about creativity. With its hundred and more definitions, creativity has been described in many ways and with just as many theories. It is difficult to agree on what creativity is, multidimensional or unidimensional, individual or collective, genius or everyday (Aleinikov et al., 2000; Kampylis & Valtanen, 2010; Kaufman & Sternberg, 2010; Runco & Jaeger, 2012; Walia, 2019; Tromp & Sternberg, 2022). What is now known with certainty, however, is that creativity plays a fundamental role in business, innovation, education and many other areas of this modern, fluid and complex society. This fundamental role of creativity in the capabilities of the next generation has become even more apparent since the spread of the pandemic (Gurung & Rutledge, 2014; Hoffmann et al., 2016; Smith et al., 2020). If attention to creativity had waned in the last decade due to difficulties in implementing interventions and good intentions in education (Florida, 2012; Haertel et al., 2017; Tienken, 2018), the pandemic has reignited interest. The long periods of living in isolation at home, the rush to digital innovation that led to distance learning and smart working, and all the discoveries in science that led to the vaccine tell of a historical period marked by creativity, flexibility and adaptability.

However, considerations arise from this new wave of interest in creativity that are not always reflected in the literature.

Several studies have shown that the pandemic, as a stressful event of global proportions, brought out the creative potential of people in their daily lives (Kapoor & Kaufman, 2020; Cohen & Cromwell, 2021; Marciano, 2021; Brosowsky et al., 2022). As a fundamental transversal skill for human adaptation to their historical environment and time, creativity has promoted individuals' psycho-relational well-being and, as a resource, supported resilience and post-traumatic growth (Mercier et al., 2021; Orkibi et al., 2021; Zhao et al., 2022). Studies had already described the relationship between creativity and resilience in the past (Metzl & Morrell, 2008; López-Aymes et al., 2020). But in the last two years, these constructs have become key players in the post-pandemic and reboot period.

Despite this, since the onset of the pandemic there is a dearth of literature that has actually focused on the relationship between creativity and resilience in this new historical context, and little is known about the impact on the psychological well-being of some vulnerable populations, such as

adolescents and young adults (Fan et al., 2021; Zeng et al., 2021; Li et al., 2022; Prasittichok et al., 2022).

Since the pandemic outbreak, university students have been become the preferred convenience sample of many studies looking at well-being (Hanel, 2020; Varma et al., 2021; Samji et al., 2022; Ravens-Sieberer et al., 2022). The results revealed the distress of this vulnerable population: depression, anxiety, loneliness, self-harm and suicide risk. Data confirming the literature on discomfort, stress and mental disorders in youths in response to the challenges posed to them by the context (Humes, 2011; Barbot & Heuser, 2017). Since 2020, risk factors have been analysed (Magson et al., 2021; Preetz et al., 2021; Verger et al., 2021) and attempts have been made to respond by proposing interventions (Flaxman et al., 2020; Karwowski et al., 2021; Cohen & Cromwell, 2021). However, studies that have explored the resources and strengths of young people are rare.

Resources also include creativity, a transversal competence that promotes lifelong learning (European Parliament and Council, 2006; UNICEF, 2022) and is a strength of the new generation that has to cope with increasingly flexible, demanding and complex educational and work contexts (Grigorenko, 2019; World Economic Forum, 2022). This focus on resources at times of particular stress is even more significant given the impact of the pandemic that young people are experiencing internationally. However, few studies in the last two years (Patston et al., 2022) have described perceived resources among young people. Moreover, the links between creativity and resilience in this population are still unexplored, taking into account the different valence of creativity factors among students from different European countries.

Finally, the lockdown, the social distancing and the impossibility of face-to-face contacts and meetings brought up again the already notorious problem of creativity evaluation. During the pandemic, people were more aware than in the past that assessing creativity online was only possible through self-report tests. On the other hand, it was not possible to measure some factors of creativity, such as process, which in some cases requires complex measurements with paper tests that cannot be replicated online. The assessment of divergent thinking, for example, is done by coding drawing tasks and is considered particularly suitable for large-scale measurement because it does not have the language bias and risk of social desirability typical of self-reports (Pásztor et al., 2015; Reiter-Palmon et al., 2019; Guo et al., 2021).

However, the design tests that currently exist are paper versions, many of which require lengthy coding to be completed by multiple researchers and refer to manuals from more than 20 years ago (Torrance, 1974; Williams, 1993, 1994). Paper-based test administration is a limitation that makes large-scale data collection complex and prevents monitoring in areas such as education. In addition, technological advances, many of which have been applied in education, have made it clear that the

new generation of digital students is different from previous generations (Bullen et al., 2011; Gurung & Rutledge, 2014; Creighton, 2018). Assessment tools used in the past may no longer be suitable to tell the creativity of young people. Digital natives or digital students represent generations who have grown up with new technologies and a different way of approaching learning. For them, the use of mobile devices or software that can support large-scale creativity assessment with rapid and automated scoring is desirable. Despite some attempts in the past (Zabramski et al., 2013; Guo, 2016), there are still few tools that enable creativity assessment in a digitized manner. Moreover, none of the existing tools are based on mobile technologies, which are so valued and used daily by young people.

These gaps in the literature led to the creation of this thesis work, hoping to provide some answers regarding the promotion of creativity among students in the post-pandemic period.

1.2. General Objective

In light of the gaps in the literature regarding the topic of this thesis work, the overall objective is to describe the relationship between creativity and psychological and social-relational well-being, in the post-pandemic period, in a population of adolescents and young adults, new generations of digital students.

1.3. Specific Objectives

The specific objectives of this work are outlined below. For simplicity, they are presented divided on the basis of the three articles that compose the second part of the thesis. The methodological aspects, organization and summary of the articles will be presented in Chapter 4.

1.3.1. Literature review on creativity and resilience in the pandemic period

The literature review aims to examine the amount and types of articles published since the beginning of the pandemic (2020) to describe and explore the relationships between creativity and resilience in adolescents and young adults. Specifically:

1 - Assess how many articles have covered the topic of creativity and resilience in relation to the post-pandemic situation.

2 - Identify the geographical origin (country) of the publications dealing with creativity and resilience.

3 - Assess how many articles measured creativity and resilience with a target group of adolescents or young adults.

4 - Describe how the constructs of creativity and resilience and any other related variables were operationalized and evaluated.

1.3.2. Factors of creativity, resilience and social support in the post-pandemic era

This cross-national study between two similar European realities, albeit with different characteristics such as Italy and Spain, aims to investigate possible differences between Italian and Spanish university students regarding the relationship between creativity factors, social support and resilience by assessing whether creativity factors predict resilience differently in the two samples, Italian and Spanish. Specifically:

1 - Are there differences in creativity factors, social support and resilience between university students in Italy and Spain?

2 - Is there a relationship between creativity factors, social support and resilience in the post-pandemic period in Italy and Spain?

3 - Do creativity factors (personality attributes, divergent thinking and problem solving) controlling for social support predict resilience differently between Italian and Spanish university students in the post-pandemic period?

1.3.3. Assessing creativity through a mobile app

The development of the TCD-D, or Test of Creativity and Divergent Thinking, in digital form is intended to replicate and update the paper version of the Williams Test for measuring divergent thinking. Specifically:

- Developing a prototype mobile application that automates the assessment of three indices of divergent thinking: Fluency, Originality and Elaboration.

- Evaluate the reliability and reliability of the three measured indices of divergent thinking.

- Evaluate the sustainability of the TCD-D mobile application with a sample of university students.

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Capitolo 2. The Creativity

2.1. Definition

More than four decades ago, Torrance (1988, p. 43) stated that "*Creativity defies precise definition*". Over the years, more than 100 definitions have been documented (Aleinikov et al., 2000; Runco & Jaeger, 2012). Thus, although human creativity is one of the most important and fascinating aspects of psychological functioning, it is still in search of a clear and unambiguous definition. Generally, creativity is thought to be the ability of humans to create something on a physical or ideational level that did not exist before and that is valued by others for its worth. One quickly realises that the problem of explaining how people can succeed in this endeavour reflects the difficulty of tracking down a clear definition of this ability (Kaufman & Sternberg, 2006). Despite these difficulties, the first step towards understanding creativity might be to define it. With this purpose, Kampylis & Valtanen's (2010) study analyzed 42 definitions of creativity, from 1950 to 2010, to capture common elements. The authors noted that most of these definitions had in common four basic components of the definition of creativity:

1. Creativity is a key ability/competency of individuals.

2. Creativity presupposes an intentional activity/process.

3. The creative process occurs in a specific context or environment.

4. The creative process involves the generation of products, that are tangible or intangible. Creative products must be new, original, unconventional and appropriate, valuable and useful to oneself or others.

These common elements are consistent with those already identified by Kaufman & Sternberg (2010):

- creative ideas must represent something different, new or innovative;

- creative ideas are of high quality;

- creative ideas must be appropriate for the task at hand or a redefinition of that task.

On this basis, a creative response is new, good, and relevant (Kaufman & Sternberg, 2010).

From the four components that characterize the definition of creativity, Walia (2019) has in recent years derived the following characteristic elements of creativity in the new millennium:

- creativity is a human act that produces something new, which can be a physical object or even a mental or emotional construct, as already suggested by Vygotsky (2004).

- creativity, as Kampylis & Valtanen (2010) noted, requires an intentional process of production rather than reproduction. Both are necessary to create, but productive activity occurs when new

experiences interact with existing knowledge and experiences to create new images and ideas (Vygotsky, 2004).

- Creativity requires disequilibrium. When everything around the individual is in equilibrium and the individual chooses to adapt to the context, conditions do not lead to creative activity (Vygotsky, 2004; Jackson, 2013). The process of creation involves a constant oscillation between equilibrium and disequilibrium. The recognition or perception of a certain disequilibrium would trigger the need to be creative (Vygotsky, 2004; Shkliarevsky, 2017).

- Creativity requires sensitivity in perceiving a problem in a particular context. The presence of sensitivity thus seems to create or detect an imbalance in the environment that triggers cognitive abilities to find productive actions (Kaufman et al., 2010).

These considerations now lead us to a dynamic view of creativity, which results from the interaction between the person, the environment and the task. The focus can thus be on one of the three components, and regardless of which is the central element or starting point of the analysis, the other two elements act as moderators that need to be taken into account for a complete understanding of creativity (Tromp & Sternberg, 2022). Walia (2019) defines it as follows: "*Creativity is an act arising out of a perception of the environment that acknowledges a certain disequilibrium, resulting in productive activity that challenges patterned thought processes and norms, and gives rise to something new in the form of a physical object or even a mental or an emotional construct*" (p.7).

Why can it still be useful today to talk about the definition of creativity?

The fact that we still find it so difficult to give a clear definition of creativity today is perhaps related to an underlying error that has persisted for too many decades. There is a constant attempt to simplify the concept of creativity, which is characterized precisely by its complexity. This attempt to reduce it to an unambiguous definition nullifies the very meaning of the construct and does not take into account its multidimensional, dynamic nature, which is highly dependent on the historical and cultural context in which it develops.

2.2. Historical Notes

As much as creativity has accompanied human history since the earliest times, various literature reviews note that it is only since the twentieth century that the topic of creativity has been the subject of in-depth research conducted according to specific investigative criteria of the scientific method (Stein, 1963; Simonton, 2001; Fisher & Williams, 2012). In particular, after the end of the World War II, three research centres on creativity emerged in the United States: in 1949, MacKinnon founded the Institute of Personality Assessment and Research (IPAR) at the University of California;

in the early 1950s, Guilford founded the Aptitudes Research Project at the University of Southern California; and finally, in 1952, Stein founded the Centre for the Study of Creativity and Mental Health at the University of Chicago (Sawyer, 2017). In the post-war period, the topic of creativity had taken on special significance, especially in psychology, because the idea began to take hold that in order to develop an open and non-conformist society, it was necessary to approach individual needs and freedoms, the ability to go against socially prescribed patterns and thus move away from conformity (Simonton, 2001; Stein, 1963). The spirit of optimism of the post-war period II is echoed by Stein's (1963) words, "*The challenge of our time does not lie in concerns with conformity, but in the challenge to create the free society that will provide these freedoms*" (p.130). Similarly, Barron (1963) wrote in those years that the creative society of the future should have "*freedom of expression and movement, no fear of dissent and contradiction, a willingness to break habits, a spirit of play and devotion to work*" (p.152).

From here on, creative ideation has been considered an important resource that enables individuals to remain flexible in the face of change, progress and opportunity in life (Runco & Jaeger, 2012; Silvia et al., 2014). As creativity becomes a useful and effective response to evolutionary changes in the individual and society, it is considered a complex, multidimensional process with many factors such as individual, environmental and situational dimensions contributing to its construction (Kaufman & Sternberg, 2010).

In addition to the interest in individual and creative personality developed in the 1950s and 1960s (Kaufman & Sternberg, 2010), the study has expanded over time to include group-level creativity and the link between contexts and individuals' behaviour (Sawyer, 2017). Space is given to the idea that the individual and society are not clearly separate dimensions and that the creative experience is therefore inherently holistic and dynamic (Runco & Jaeger, 2012). The traditional notion that creativity is fully anchored in the individual and not influenced by society, which stands outside the creative process, is thus overcome (Glăveanu, 2017).

The social and political changes of the 1950s and 1960s and the more open socio-cultural climate made it clear that creative abilities were not an exceptional gift bestowed on a few, but inherent in everyone in different forms and qualities (Silvia et., al, 2014). This made it possible to foster creativity in everyday contexts, among people of all social classes, genders and ages. This finally overcame the notion that had long described creativity as a skill reserved for a few, genius individuals (Sawyer, 2017).

In the last decades of the 19th century, it was realized that sustainable development required a focus on creativity, which is recognised to promote social change and economic growth. Indeed,

without it, the potential for continuous innovation in products, services and entrepreneurship would be lacking (Zeng et al., 2010).

In parallel with its importance in the socio-economic sphere, in 1993 the World Health Organisation (WHO) included creativity in the list of life skills for the development and positive adaptation of individuals to their environment and subjective well-being. In this way, WHO affirms the fundamental role of creativity in the development and well-being of the individual and society, and thus also sets the lines of development for the new millennium (WHO, 1993).

In 2006, the European Parliament and Council included creativity as one of the eight key competences of lifelong learning and consequently developed a comprehensive plan for education and training that uses creativity in the personal, interpersonal and intercultural fields (European Parliament and Council, 2006). The year 2009 was proposed by the European Parliament and Council as the *Year of Creativity and Innovation*. The aim was to create a link between artistic and technological environments, which are two of the most important contexts for the implementation of creativity and innovation (Council of the European Union, 2008).

Thanks also to the initiatives promoted by the European Parliament and Council on these issues, the first years of the new millennium are seeing a renewed interest in creativity related to innovation and new technologies. Not only scientific research, but the whole of civil society is beginning to realise the importance of disseminating creativity in the service of innovation (Runco, 2011). Innovation, a fundamental feature of the globalised world, is considered a concept of multidisciplinary interest and is defined as the development of the product or practise of new and useful ideas for the benefit of individuals, teams, organizations or a broader stratum of society (Bledow et al., 2009). It is only since the early years of the new millennium that the study of creativity and innovation as common concepts has also entered the psychological literature (Agars et al., 2008). According to Runco (2011), there is a threshold of creativity that is necessary for innovation. Nevertheless, for a long time the two concepts were even considered synonymous, as in many cases the end product was considered the same (De Breu et al., 2011). However, the literature has challenged this view. Authors such as Somech and Drach-Zahavy (2013) noted that most studies refer to innovation as a general concept without considering the two phases that constitute it: the creativity phase, i.e. the generation of new ideas, and the implementation phase, i.e. the successful realization of creative ideas (Nakano & Wechsler, 2018).

In the wake of innovation, new technologies and modern society, creativity has become a priority on the political, social and educational agenda in many countries over the last decade (Florida, 2012). A priority in Europe and North America, where identity, society and culture require new forms of teaching and learning aimed at promoting cultural identity, creativity and social cohesion. But also,

a priority in Asian and Pacific countries where, as knowledge societies develop, one of the challenges is to foster imagination, creativity and collaboration (Newton & Newton, 2014).

Why is it still important to remember the historical development path of creativity from the post-World War II period to the present?

Creativity in the 1950/60s developed under the influence of scientific and social movements of great innovation, growth, social development and emancipation, but above all of a new beginning after the dark times of the war. This enthusiasm is waning at the beginning of the new millennium (Florida, 2012). Technological breakthroughs prove to be more profitable and less complex to implement. Today, in the post-pandemic era, we find ourselves fatally in a period similar to the post-war era: a time of revival, reconstruction, innovation and resumption of social and economic activities. Just as in the 1950/60s, creativity plays an important role that can support adaptation to the new historical and cultural context and promote well-being and innovation for individuals and society (Kapoor & Kaufman, 2020).

2.3. Theoretical models of reference

Over the last century, several models and theories of creativity have been developed. Almost as many as there are definitions supporting the idea that creativity is indeed a dynamic construct that develops within its cultural-historical context. However, the basic idea underlying most contemporary models and underlying the entire thesis work, concerns the concept of everyday creativity, defined as human originality expressed in the various activities of daily life (Kaufman & Sternberg, 2010). It is considered central to human survival and is present in everyone to some degree. Since everyday creativity is not only about what one does, but also how one does it, certain components of creativity are observed, such as process and product (Kaufman & Sternberg, 2010). The two main models guiding this work, briefly outlined below, define the elements and gradients of everyday creativity and its development over the life cycle.

2.3.1. The 4 P's model

This thesis work is based on two theoretical models, the oldest of which is Rhodes' (1961) 4P model.

The "Four P's" of Creativity:
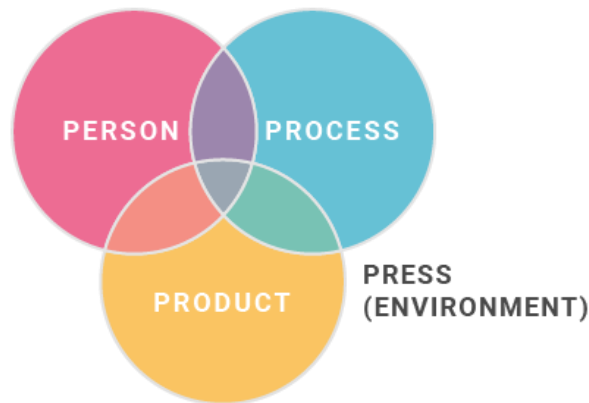
Figure 1. Rhodes' 4 P's model of creativity (1961) [1]

According to the author, the 4Ps define the four elements that dynamically interacting with each other: *person, process, product* and *press* (context) (Zeng et al., 2010).

The creative *person* describes the attributes and personality correlates that most characterize creative individuals or those who perceive themselves as such. Although creative potential is present in all people (Gentile, 2014), individual and cultural-historical contextual factors can favour or work against the expression of the creative personality. The characteristics, which distinguish the creative person are different: for example, openness to new experiences, curiosity, extroversion, autonomy, independence, ambition, perseverance and impulsivity (Feist, 2019). To date, creative personality is generally considered an influence on creative behaviour rather than a complete explanation of individual creativity per se (Feist & Barron, 2003).

The *process* of creative thinking is also referred to as creative cognition and includes cognitive processes and metacognitive strategies (Zeng et al., 2010). Specifically, it refers to the mental operations performed by individuals during the creative ideation phase, such as when redefining a problem (Sternberg, 2018). It is discussed in more detail in section 2.3.1.1.

Product refers to the results of the creative process, such as a poem, a portrait, a sculpture, a symphony, a scientific discovery, a choreography or something else. A creative product should be both new and valuable to qualify as such (Rhodes, 1961; Sternberg, 2018).

Press refers to the pressures exerted by the environment/context in which the creative person operates, where the creative process takes place and where the creative product is made. In particular, it refers to the environmental forces that stimulate creative thinking and behaviour, such as

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[1] Image from https://rogerfirestien.com/4ps-of-creativity/

interactions within and between groups, extrinsic motivators and societal needs at a particular historical point in time (Sternberg & Karami, 2022).

Rhodes' (1961) 4 P's were theorised some sixty years ago, but are still considered contemporary because it is one of the few models that fits perfectly in different contexts, regardless of cultural-historical features (Sternberg & Karami, 2021). For example, the 4 P's are excellent at describing the elements of creativity in educational contexts: the creative people, such as teachers, students and educational staff; the creative process, i.e. the processes of learning and teaching; the creative product, whether expressed through school grades, ideas produced in the classroom or student learning goals; and finally, the press, the creative environment, such as the classroom, in which the individual and context interact (Riga & Chronopoulou, 2014; Tsurusaki et al., 2017).

This is just one of countless examples that could be proposed in business, sport, economics, health, etc. (Runco & Kim, 2020). The other reason that has made this model immortal and ensured that it has survived over the years, surpassing even more recent models in prominence and usefulness, is the contribution of other authors. Indeed, the 4P model became known a few decades ago as the 6P model (Sternberg & Karami, 2021) and today as the 8P model (Sternberg & Karami, 2022).

Over the years, several authors have added the 'p', updating a model to reflect this change. In particular, Simonton added the fifth 'p' for *persuasion*. According to Simonton (1990), creative outcomes tend to change the way others think: in this sense, they are persuasive. The notion that creativity is an element of persuasion is consistent with the assumptions of the social perspective (Amabile & Pillemer, 2012) and Csikszentmihalyi's (1999) systems model. According to him, persuasive individuals are those who can influence the direction that a particular field takes (Kozbelt et al., 2010).

About a decade later, Runco (2006) proposed *potential* as an additional element. Potential is particularly useful for the educational sector and for creativity development, because students often have potential that is not yet manifested in clear products or creative achievements, but needs recognition. The following year, Runco (2007) also proposes a new categorization of Rhodes' 4 p's, with the new additions: at the most general level, he distinguishes between two macro categories of elements, creative performance and creative potential. Products and persuasion underlie performance: both presuppose the existence of an actual manifested creative effort. The second macro-category, on the other hand, comprises person, process and press. These do not presuppose manifest performance, but can lead to it and are therefore defined as potential (Runco, 2007).

In parallel, Sternberg (2022) proposes to add 4 P's to the original 4 P's in Rhodes' (1961) model, namely: purpose, problem, propulsion and public. According to this new 8 P model:

I. Purpose: indicates what the creativity is for. The purpose is to create something new and useful that has a positive, i.e. constructive and potentially helpful effect on society, or something destructive that can cause harm to a cause or a person.

II. Pressures: The forces in the environment that drive people to do creative work. This can be out of a perceived need, for economic reasons, to do the "right thing" or to do good.

III. People: the qualities of creative people, such as intelligence, personality, motivation, thinking style and openness to change.

IV. Problems: the tasks and situations that require a creative solution. The different nature of the problems that can be creatively addressed determines the domain-specific nature of creativity itself.

V. Processes: the mental operations and thus the creative thinking that leads to creative production.

VI. Products: the results of creativity.

VII. Propulsion: refers to the way and speed with which a creative idea or product changes a domain or a way of thinking. Creative work is new: it changes something in some way.

VIII. Audience: plays a key role in creativity at the highest levels (see Pro-C and Big-C in section 2.3.2.). It is the audience that decides which products are new and which are useful. Without it, creativity at the higher levels would become less important, as there is no absolute standard for judging what is new and useful. Moreover, the audience gives feedback to the creative about what they value and what they do not consider creative.

2.3.1.1. The Creative Process

The previous paragraph discussed how the 4 P's of Rhodes transitioned to 2022, making this model truly contemporary and a source of inspiration for many other authors of the new millennium (Sternberg, 2022). But in any version of the 4, 6 or 8P's, the element that most of the scientific literature on creativity focuses on is precisely the creative process. It is the sequence of thoughts and actions that leads to new and adaptive production, one of the main themes of creativity research over the years (Lubart, 2001; Kaufman & Sternberg, 2010).

It is important to remember that there is no absolutely unified model that can specifically and completely define human creative processes (Zeng et al., 2010). However, there is a consensus in the literature that the creative process is synonymous with creative thinking (Gentile, 2014), which is fundamental in cognitive processes because it enables a better understanding of problem situations by hypothesising alternative, original and innovative solutions. It is also called *productive thinking*

(Vygotsky, 2004) or *divergent thinking* (Guilford, 1961) and gives the mind the opportunity to explore a variety of solutions without following a predetermined path (Gentile, 2014).

Guilford (1961, 1968) was one of the first to describe the process of creative thinking in detail, describing the two main components. Indeed, the process of producing creative ideas was distinguished into divergent thinking, i.e. thinking that moves in directions different from the ordinary and is therefore original and unexpected, and convergent thinking, which works logically and compares new thought processes with patterns already known.

Even outside the purely psychological domain, divergent thinking refers to the ability to "*think outside the box*" (Gilhooly et al., 2007; Wahba, 2019), i.e. to find a range of possible solutions to a given problem. However, it is always accompanied by convergent thinking, i.e. the way of finding an exact solution in which individuals tend to "converge" (Guilford, 1968; Peterson & Pattie, 2022).

Today we know that divergent and convergent thinking play a key role in creative performance (Runco, 2011; De Vries & Lubart, 2019). Divergent thinking is characterised by originality of ideas, conceptual fluidity, sensitivity to problems, the ability to reorganize elements, the production of many different responses to each other, personal revision, critical sense, and it is through this thinking that the part of creativity that is reformulated is expressed (Guilford, 1968; Gentile, 2014). Divergent thinking, however, comes into play only when convergent processes have developed to the point where stable patterns have emerged that allow adequate mastery of the topic or domain of application. Thus, for a given problem to be solved satisfactorily, it is necessary to integrate these two ways of thinking, as they complement each other (Runco, 2011; Gentile, 2014; De Vries & Lubart, 2019).

Although divergent thinking is only one component of the creative process, it is considered a predictive indicator of creative potential, especially from an educational perspective (Runco & Acar, 2012; Reiter-Palmon & Barbot, 2019). Divergent thinking is a way to train individuals, especially young people, to produce knowledge, seek ideas and solutions to a problem. In addition, the creative process has been shown to promote critical thinking, self-motivation and students' mastery of skills and concepts (Henriksen et al., 2018).

Divergent thinking is one of the areas of creativity for which most assessment tools have been developed (Kaufman & Sternberg, 2010). Some of the earliest instruments developed to measure it in the middle of the last century are still among the most widely used, such as Guilford's divergent production tests (Structure of the Intellect, SOI) (1962) and Torrance's Test of Creative Thinking (TTCT) (1974). Some divergent thinking assessment instruments have also become popular because of their cross-cultural invariance, such as the graphic production tests. These can be more easily adapted and used globally without the risk of bias or cultural gaps, as they contain almost no verbal component (except for instructions) (Kim & Zabelina, 2015; Guo et al., 2021).

Among the tests for divergent thinking, the Torrance test is the one currently most used, discussed and adapted in the literature (Yarbrough, 2016; Bart et al., 2017). The Torrance test is based on Guilford's theoretical formulation and includes four main factors to measure divergent thinking:

- fluency, the ability to produce a large quantity of ideas

- flexibility, the ability to move from one category of thinking to another

- originality, the ability to come up with unusual ideas

- elaboration, the ability to fully pursue creative thinking and enrich it with details (Torrance, 1974).

In general, these four factors are common to almost all tests that assess divergent thinking by measuring it in graphical or verbal form (Reiter-Palmon & Barbot, 2019). For example, the same four indices are used in the draw protocols of the Creative Assessment Packet (CAP). This test was developed by Williams (1993) to assess divergent thinking and, in particular, cognitive factors related to creative behaviours. This instrument was developed specifically for the educational context with the aim of making teachers more aware of the development of their students' creative potential. Similar to the Torrance test (1974), the CAP consists of a verbal section, a questionnaire and a graphic section, i.e. drawings obtained by completing a graphic stimulus (Williams, 1993). Unlike the Torrance test (1974), which is mainly used in the United States, the CAP enjoys great popularity in the East, especially in China (Fan et al., 2021; Wang & Deng, 2022) and in some European countries such as Italy (Antonietti & Cornoldi, 2006; De Caroli & Sagone, 2007; Lucchiari et al., 2019), where it is known as the Test of Creativity and Divergent Thinking (TCD; Williams, 1994).

Finally, the creative process is not only understood as creative and divergent thinking, but is sometimes represented by the constructs of problem finding and problem solving. Although problem-finding and problem-solving are often used as skills other than creativity, creative thinking follows a process that many authors equate with the ability to identify and solve problems in one's context (Mayer, 1999; Runco & Dow, 1999; Lubart, 2001; Dostál, 2015; Rahman, 2019).

Problem finding, defined as the set of processes to identify a problem in its context in order to solve it, plays an important role in creative thinking. In fact, the creative process leads to good products when one has the ability to identify the problem rather than solve it. Even in everyday contexts, problem solving may depend on problem identification and problem definition, both processes of problem identification (Runco & Dow, 1999; Runco & Jaeger, 2012).

Problem solving is a cognitive process that aims to transform a given situation into an objective situation when the individual has no immediate solution method and it is necessary to apply a creative process (Mayer, 1999; Lubart, 2001). Creative problem solving is a process because it triggers a series of mental operations. The person, who has no experience with similar problems, has to find a new

way to solve the problem (Dostál, 2015; Rahman, 2019). Problem solving refers to productive thinking that occurs when a problem solver invents a solution procedure that is new to him or her (Mayer, 1999; Vygotsky, 2004). It is common to distinguish two main phases of problem solving: problem representation and problem solving. In the first phase, a mental image of the problem is created to visualize its components. In the second phase, the individual designs a plan to solve the problem and implements it through the sub-processes of planning, execution and monitoring (Mayer, 1999; Rahman, 2019).

2.3.2. The 4 C's model

This thesis work is guided by a second model related to the typology of creativity. Since the World War II (as explained in more detail in section 2.3.1), thanks to a more open socio-cultural climate, the creative capacity is no longer reserved for a few (exceptional gift of genius), but has become a capacity that everyone possesses in different forms and qualities (Silvia et., al, 2014). The first model to conceptualize this difference is that of Arieti (1976), who hypothesises that there are two types of creativity. The little-c, ordinary creativity (with a small "c"), which is inherent in every individual, typical of everyday life and of experiences and expressions accessible to most people: for example, the original way in which a new recipe is cooked that is praised by family and friends. Big-C, on the other hand, is exceptional creativity (with a capital "C") where the creative process leads to socially recognized innovations, referring to distinctive examples of creative expression (e.g. Beethoven's music or Van Gogh's paintings) (Kaufman & Sternberg, 2010). Arieti (1976) considers "big-c" and "little-c" not as distinct but as extremes of a single continuum. Kaufman and Beghetto (2009) later extended this theory with their "Four C model of Creativity" Based on the continuum already theorized by Arieti (1976), Kaufman & Beghetto (2009) hypothesise that creativity can be divided into 4 types of creative products, produced by individuals exposed to different environmental pressures and problems: mini-c, little-c, Pro-c, Big-C (Sternberg & Karami, 2022).

mini-c	little-c	pro-c	Big-C
transformative learning, personally meaningful interpretations of experiences, actions and insights		creative acts of experts/experienced people & teams within an organisation, community or domain	eminent creativity of exceptional people
	everyday creative thoughts and actions in every aspect of our lives	impact on an organisation, field, system of practice, or market	impact on culture, society, the world
changes in our understanding			
impact on individuals	impact on individuals and their zone of influence		

Context for new ideas & their implementation (vertical axis)

Socio/cultural significance and impact (horizontal axis)

Figure 2. Kaufman & Beghetto's four C's model of creativity (2009)[2]

Mini-c is meant to describe everyday creativity: it refers to new and personally meaningful interpretations, ideas and insights (Beghetto & Kaufman, 2007). Similar to Niu and Sternberg's (2006) idea of individual creativity, mini-c highlights the personal, internal, expressive, and evolutionary aspects of creativity (Stein, 1953; Runco, 2004; Helfand et al., 2017). This view is in line with Vygotsky's conception of cognitive and creative development, according to which all individuals have creative potential that begins with the internalization or appropriation of cultural tools and social interaction (Vygotsky, 2004). What is new about this form is that the focus is not on the creative product, but on the process, which does not require any external judgement and does not need to be shared or acknowledged by anyone except the person who creates it. This type of creativity is most easily observed in educational contexts, where students are constantly exposed to new learning and make personally meaningful progress, although anyone can experience creative mini-thinking in any other context (Helfand et al., 2017).

This is followed by little-c, which emphasizes the relevant role that creativity plays in daily life with interpersonal implications. The effects of little-c thus affect not only the individual who experiences them, but also his or her close social network, which benefits from them. As this is also about everyday creativity, it reminds us of the importance of recognising and fostering creative

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[2] Image from https://twitter.com/academiccreator/status/656887428515504129

processes in everyday contexts such as school, work, home and social settings (Kaufman & Beghetto, 2009).

The third typology on the continuum is Pro-c, which represents evolutionary progression and engagement beyond little-c, but has not yet reached Big-C status. Pro-c creativity focuses on individuals who have been successful but have not yet reached a level that makes them immortal (Kaufman & Beghetto, 2009; Helfand et al., 2017). Anyone who achieves recognized professional competence in any creative field is therefore likely to have achieved Pro-c status. The concept of Pro-c is consistent with the approach to creativity based on the acquisition of skills in an increasingly specialized manner (Ericsson et al., 2007).

Finally, Big-C is the type of creativity that occurs in those who are able to produce discoveries or inventions that change or impact society, as in the case of Darwin's theory of evolution, Beethoven's Ninth Symphony or Picasso's Guernica (Sternberg & Karami, 2022). Creativity becomes increasingly domain-specific as we move from mini-c to little-c, Pro pro-c, and Big-C (Kaufman & Beghetto, 2009).

This model represents a trajectory of creativity development in a person's life. It is not necessarily a step-by-step developmental progression, but a framework for conceptualizing and classifying the various levels of creative expression, showing the possible pathways to creative maturation (Kaufman & Beghetto, 2009).

2.4. Creativity in the educational context: old challenges and new goals

As can be seen from the previous sections, contemporary models of creativity aim to discredit the innate myth of creative genius and make the use of creative processes everyday in all contexts of an individual's life (Kaufman & Beghetto, 2009). Furthermore, an important focus is placed on the creativity gradient: even a small act of creativity that is not shared and not necessarily accepted by others can make a difference to the individual experiencing it, at any age and in any context (Kaufman et al., 2016). However, some contexts, more than others, seem to be naturally predisposed to accommodate creative processes that need to be fostered, monitored and enhanced if it is hoped that they will develop in a pro-C direction (Kaufman et al., 2016). For example, taking into consideration the World Economic Forum's (2020) vision that creativity will be a crucial aspect of employability in the coming decades, several national and international educational institutions, such as the Organization for Economic Cooperation and Development (OECD), are developing programs to promote creativity in the classroom and in educational settings (De Vries & Lubart, 2019; Grigorenko, 2019). The educational context is thus confirmed as one of the areas that contributes most to fostering creative potential, although not without difficulties.

Creativity is recognized as the most important learning competence of the 21st century (Wang & Murota, 2016; Patston et al., 2021; Grey & Morris, 2022). It is considered one of the major transversal competencies, i.e. a comprehensive set of skills that are not specifically related to a particular job, task, discipline or field of knowledge and can be used in a variety of situations and contexts (OECD, 2019; Grey & Morris, 2022). UNICEF (2022) considers creativity as one of the 12 core competencies that promotes academic achievement and helps discover students' diverse talents.

Figure 3. UNICEF's 12 transferable skills (2022)[3]

Creativity helps to cope with and constructively participate in new, complex and ever-changing technological and digital contexts (Grigorenko, 2019). In addition, creativity strengthens adaptability in different life situations and leads to solutions, methods and processes for dealing with old problems and contemporary challenges (Patston et al., 2021). Through the use of creativity, students develop a sense of self-efficacy and perseverance, leading to a sense of empowerment, while social creativity encourages students to be even more creative and to combine different ideas, sometimes even across cultures (Lucas & Venckute, 2020).

The European Council (2008) already identified education and training as crucial factors for a more competitive Europe two decades ago: knowledge and innovation are considered the beating

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[3] Image from https://www.unicef.org/lac/en/transferable-skills-development

heart of European growth. Member States and the Commission were therefore called upon to develop an innovative education sector that is also based on creative skills (CEU, 2008; Grigorenko, 2019). More recently, favoured by the rise of Industry 4.0 and increased demands in the technology sector, creativity has become one of the three key competences in the OECD Education 2030 project (OECD, 2018). As a result, creativity is no longer considered a marginal topic or luxury in the curriculum, but a key competence that should be promoted in all subject areas (Patston et al., 2021).

In general, there are two main premises that support the creative approach to education: creativity can be developed (Kaufman & Beghetto, 2009; Helfand et al., 2017), and all individuals possess the potential to be creative (Runco & Jaeger, 2012; Silvia et al., 2014; Sawyer, 2017). Moreover, we now know that creativity and innovation in educational settings are not just an opportunity, but a necessity (Ferrari et al., 2009; Patston et al., 2021). In particular, mini-c and little-c (previously discussed in section 2.3.2.) are well suited to be developed in the educational context, where the priority is to encourage all students to reach their full potential (Kaufman & Beghetto, 2009; Newton & Newton, 2014). This is an inclusive and democratic perspective that assumes that all people are capable of creativity from an early age and that every student has creative potential that can be nurtured or inhibited depending on the type of stimuli they receive in the educational context (Ferrari et al., 2009; Newton & Newton, 2014).

2.4.2. The obstacles of creativity at school

In view of the countless benefits of creativity in solving complex individual, social, and global problems (Newton & Newton, 2014; Patston et al., 2021), we would expect a major effort to promote creative potential in education (Beghetto, 2005). However, efforts to foster students' creativity are often overshadowed by a multitude of other demands and problems that hinder their promotion and inclusion in the curriculum (Beghetto, 2005; Newton & Newton, 2014).

The main problem that interferes with the inclusion of creativity in education concerns a tacit knowledge about creativity that manifests itself among teachers, parents, students and other educational stakeholders through the dissemination of false myths. Over time, this knowledge has given rise to a number of implicit theories that explain how ordinary people think about creativity, but which differ greatly from the scientifically supported theories known as explicit theories (Ferrari et al., 2009; Uszyńska-Jarmoc & Kunat, 2020).

Among the false myths that have hindered their inclusion in the school, for example, is that:

- it is still wrongly assumed that creativity is only used in the arts subjects, whereas today it is demonstrably a cross-curricular skill that can be used in any school subject;

- creativity was even played off against knowledge in the past, whereas today we know that knowledge is indispensable to be able to implement creative thinking;

- creativity used to be considered a pure talent, i.e. an innate ability, but it has long been known that creativity can be learned and trained;

- creative learning has been associated with a time of pure fun, play and random occurrences of creative processes. In reality, behind all creative learning, in a situation characterized by fun and play, there is also intense critical thinking and problem solving that often needs to be stimulated, especially in younger people (Ferrari et al., 2009; Uszyńska-Jarmoc & Kunat, 2020).

Other obstacles to the promotion of creativity in the education system include: problems with the timing of education and the educational goal that needs to be achieved in a short time and almost always with scarce resources, without clarity on how to integrate creativity into the curriculum (Craft, 2005; Cheng, 2010; Wang & Murota, 2016).

While material resources are not always necessary for the implementation of creativity, time is the real resource that makes the difference. All creative activities need more time to allow students to engage in their thinking processes without the pressure of a looming deadline (Davies et al., 2013). Slow time, then, is utopian to the rhythm of today's school system, which often resorts to extracurricular activities to achieve set goals (Wang & Murota, 2016).

Regarding the possibility of introducing creativity into the different disciplines of the curriculum, it should be noted that creative thinking as a cross-curricular skill can easily be introduced into the classroom through innovative methods (Ferrari et al., 2009; Newton & Newton, 2014). But this cross-curricular use of creativity can be complex, considering the false myth that sees it as exclusively anchored in the arts disciplines (Ferrari et al., 2009).

Furthermore, there is a widespread perception that the education system suppresses rather than promotes creativity (Humes, 2011). This is because in formal education, there is a tendency to look for a ready-made, packaged and known answer even before the question can be asked, thus discouraging students from investigating and researching the answer(s) themselves (Ferrari et al., 2009; Pecheanu & Tudorie, 2015; Wang & Murota, 2016). This thought process refers only to one type of intelligence and learning, which ignores the richness of individual diversity (Ferrari et al., 2009; Kaufman & Sternberg, 2010). But creativity, which implies originality and uniqueness, is fundamentally incompatible with the uniformity and standardization of school-factory products described by Grigorenko (2019). Apart from the various specific subjects, what the school teaches is above all a way of thinking based on logic, mathematics and reasoning, i.e. a way of thinking based exclusively on the left hemisphere of the brain. In short, school teaches us to think with half a brain (Pecheanu & Tudorie, 2015).

In these considerations, there is space for the desirability paradox, according to which teachers tend to prefer standard answers over original ones because the current classroom culture does not value creative answers (Beghetto, 2007; Kaufman et al., 2016). The paradox is also reflected in teachers' preferences for certain types of ideal students. Indeed, teachers prefer compliant and caring students, traits that stand in stark contrast to creative personality attributes (Runco, 2004; Ng & Smith, 2004). The more creative a class becomes, the less desirable their behaviour appears in the eyes of teachers, as creative behaviour is often associated with scepticism, rebellion and poor teaching (Ferrari et al., 2009; Humes, 2011; Newton & Newton, 2014). Teachers are at odds with students' views. Indeed, the literature has shown that creativity is one of the qualities most valued by students throughout their schooling (Cheng, 2011; Uszyńska-Jarmoc & Kunat, 2020). Nevertheless, it should not be forgotten that while students are the main actors in education, their current power to actively contribute to institutional change is limited; indeed, they continue to be perceived as the ultimate recipients of methods and knowledge (Ferrari et al., 2009; Uszyńska-Jarmoc & Kunat, 2020).

The final but crucial aspect concerns assessment, which has been identified as one of the main contributors to the inhibition of creativity in schools (Lucas et al., 2013; Bolden et al., 2020). Specifically, there are three reasons why assessment is a barrier rather than a catalyst to creativity: the first relates to teaching organized by subject and the consequent difficulty of interdisciplinary work and cross-curricular assessment of creativity; the second relates to the historical link that exists between creativity and arts subjects, but not so much for science subjects, so that it is not seen as possible to implement and assess creativity; the third refers to the importance given to academic achievement and assessment of progress, which is only associated with certain school subjects that are considered to be of high status, such as literature, mathematics and science (Lucas et al. , 2013; Lucas, 2016).

Research has shown that in learning experiences that involve competition and comparison with others, the pressure of assessment can cause anxiety and undermine students' motivation and ability to be creative (Hennessey, 2010; Collard & Looney, 2014). Not surprisingly, teachers often resist assessing creativity because they fear it will discourage students from self-expression or because they simply believe creativity is too subjective to be assessed (Lucas et al., 2013; Bolden et al., 2020).

For more than a decade, attempts have been made to develop an approach to assessing creativity that is rigorous enough to ensure credibility and simple enough for teachers to use independently (Lucas et al., 2013; Collard & Looney, 2014). Assessing creativity in the school context would finally allow the importance of creativity to be emphasised in the curriculum and encourage the development of classroom activities that adequately support it. It would also enable an applied view of creativity

on learning processes, allowing teachers to track students' progress and provide them with more appropriate formative feedback to develop creative potential more effectively (Lucas et al., 2013).

Teachers can use feedback to encourage students to move from mini-c interpretation to little-c expression. But how? For example, by taking the time to listen and try to understand how students interpret what they are learning, or by providing multiple opportunities for students to practise developing skills in a particular area or task. In short, supportive feedback highlights students' creative strengths and also points out creative limitations that they can continue to work on (Kaufman et al., 2016).

2.4.3. Teaching and learning: creative processes at school

To describe the interaction between creative processes in an educational setting, Lin (2011) has described three interrelated elements: creative teaching, teaching for creativity and creative learning (Lin, 2011). In this educational model, teaching and learning are not two parallel processes that rarely meet, but rather are strongly interconnected and complement each other. When speaking of creative teaching, it refers to imaginative, dynamic and innovative approaches that stimulate students' imagination so that they can produce new ideas (Jeffrey & Craft, 2004; Uszyńska-Jarmoc & Kunat, 2020).

In contrast, creativity teaching, i.e. strategies to promote creativity, aims to arouse curiosity and motivation to learn (Lin, 2011; Uszyńska-Jarmoc & Kunat, 2020). Through creative teaching, teachers foster students' creativity by instilling enthusiasm, imagination and originality, while teaching for creativity creates a stimulating learning context to solve problems and appreciate students' creative contributions (Jeffrey & Craft, 2004; Lin, 2011; Uszyńska-Jarmoc & Kunat, 2020).

The third process is creative learning, as opposed to learning by authority. In fact, while students who learn through authority passively experience rules and content, those who learn through the creative process co-construct knowledge through questioning, inquiry, manipulation, experimentation and purposeless play. Students are allowed to explore their curiosity and discover answers for themselves (Lin, 2011).

It is becoming clear that the relationship between creativity and education is crucial to foster personal development and self-actualization so that young people can be equipped with the basic skills for future life (Lin, 2011; Collard & Looney, 2014).

So, what are the practical steps that can be taken to promote the use of creative thinking in the classroom?

The literature is full of suggestions, such as encouraging teachers to use questions to develop curiosity and imagination (Tran et al., 2017).

A number of creative thinking tools have been developed, including lateral thinking tools, mind maps, creative writing and drawing, which can help students develop new ideas. In addition, new technologies (e.g. creative software, games, social interaction networks) are considered effective tools for fostering creativity (Ferrari et al., 2009; Tran et al., 2017).

At the same time, students' creativity has been found to benefit from the company of peers. Indeed, peer collaboration, group work and intergenerational participation have been recognized as important elements of school environments to foster students' creativity (Grigorenko, 2019).

Inspired by Rhodes (1961), Resnick (2014) has developed a model that identifies the four P's of creative learning for designing environments and experiences:

- Projects: we learn best by actively working on projects where we improvise, adapt and sharpen our ability to understand and find solutions to any problem.
- Peer: learning thrives as a social activity where people share ideas and work together. In professional life, people rarely work in isolation, which is why the ability to work constructively with others is so important.
- Passion: people make their most creative contributions when they follow their passions rather than when they are motivated by external rewards that stifle rather than encourage creative thinking. The educational challenge is to help students identify their passions and then give them the support they need to turn their ideas into action.
- Play: learning is about experimenting through play. Play teaches us to fail early and often and to learn from mistakes, which is essential for anyone who wants to innovate.

2.4.4. Creativity in higher education

Meeting the needs of an increasingly complex and globalized society, requires education must emphasise creative competence in the development of its students (McWilliam & Dawson, 2008; Hallman et al., 2016; Haertel et al., 2017; Jahnke et al., 2017). Higher education in particular plays a crucial role in the development of creativity in young adults (Egan et al., 2017; Aktas, 2017). Although it has only become a topic of particular scholarly interest in the last decade, mini-c can also be easily promoted through higher education to encourage all students to reach and realize their full potential (McWilliam & Dawson, 2008; Papaleontiou-Louca, et al. 2014). Creativity is a fundamental skill for young adults to cope with the ambiguous, complex and rapidly changing world ahead (Aktas, 2017; Ehtiyar & Baser, 2019). Indeed, higher education can be seen as the final step for young adults to develop their creative thinking skills by entering the world of work (Ehtiyar & Baser, 2019).

Moreover, creativity has been identified as a driver of the new digital economy, which has increased the interest of universities in fostering creative thinking in view of a more technologically

driven labour market (McWilliam & Dawson, 2008; Papaleontiou-Louca et al., 2014; Hallman et al., 2016; Aktas, 2017; Jahnke et al., 2017; Ellis, 2022).

For these reasons, universities have, at least at the theoretical level, introduced strategic plans, policies and curricula over the last decade, as well as established study centres to promote creativity (Hallman et al., 2016; Aktas, 2017; Ellis, 2022). Today's universities should evolve in parallel with Industry 4.0, which requires networked digital services and a new vision of teaching and learning with the application of innovative practises and approaches (McWilliam & Dawson, 2008; Ehtiyar & Baser, 2019). At the same time, students should be young adults with a strong sense of self-worth and a desire to be original, creative and flexible in dealing with rapid changes in society (Aktas, 2017).

However, it seems that there is no room for originality and novelty in university teaching (Papaleontiou-Louca, et al. 2014). In fact, creative thinking is not adequately encouraged and considered in the university (Ehtiyar & Baser, 2019). Recent studies (Hallman et al., 2016; Ehtiyar & Baser, 2019) argue that the university environment is not sufficiently stimulating to produce changes in students' creativity. A large proportion of them even claim that university education has negatively affected their creative potential. This is because the education system has focused on a convergent and conformist mindset that teaches university students, as well as younger students, the right answer rather than the creative answer (Papaleontiou-Louca, et al. 2014; Susnea et al., 2014). Especially at the university level, teaching methods should focus on more than just teaching content and memorization of information (Papaleontiou-Louca, et al. 2014; Ehtiyar & Baser, 2019). University students should be trained to inquire and investigate, solve problems, take risks, think critically, evaluate and act with great confidence. To stimulate them in this direction, teaching should include a variety of approaches and the promotion of curiosity, self-regulation and intrinsic motivation to foster creativity (McWilliam & Dawson, 2008; Ehtiyar & Baser, 2019).

One of the obstacles again concerns the definition of creativity (McWilliam & Dawson, 2008; Jahnke et al., 2017; Ellis, 2022). Moreover, despite their interest in creative thinking, students remain recipients and spectators, almost never agents and actors in the creative process (Papaleontiou-Louca, et al. 2014). Although students' perceptions of creativity also differ depending on their field of study (Ehtiyar & Baser, 2019). Several studies claim that students associate creative potential with innovation tendency and entrepreneurial potential; they also state that creativity influences their intellectual abilities and they consider it an important aspect of their personal development and future career (Hallman et al., 2016; Aktas, 2017; Ehtiyar & Baser, 2019; Uszyńska-Jarmoc & Kunat, 2020).

Even for university students, the assessment of creativity remains a hot potato in need of revision (Ehtiyar & Baser, 2019). Currently, only grades, projects and theses are assessed in higher education. Only rarely is creativity a target of assessment processes (Ehtiyar & Baser, 2019). University students,

unlike younger students, are not often assessed, and observing teaching in classes with a large number of participants makes it difficult to assess the process. At the same time, university students who are not yet in the job market do not produce an assessable gain as is usually the case for adult creativity. Therefore, assessment in general and all indicators normally considered in other contexts are even more complex to implement (Jahnke et al., 2017).

Based on these considerations, it is clear that the higher education system, curricula, teaching and assessment techniques need further changes for universities to play a role in fostering creativity, positively influencing careers and preparing students for future challenges and opportunities (Ehtiyar & Baser, 2019). In this way, universities will not only be knowledge factories, but also open zones where social change and cultural creativity can flourish (Papaleontiou-Louca, et al. 2014).

To move in this direction, as for lower levels of education, the academic literature has developed several directions, tips and programmes to properly implement and assess creativity (Papaleontiou-Louca, et al. 2014; Haertel et al. 2017; Ehtiyar & Baser, 2019). The model developed in Germany (Haertel et al. 2017) to identify six recommended creativity indicators for university students is described below:

1. Reflective learning: reflecting on all the information provided by a teacher rather than just absorbing it and reproducing it in assessment situations.

2. Autonomy: curricular structures tend to limit the freedom of students to find their own ways of learning. A simple way to foster creativity is to restore their autonomy and agency by encouraging them to make their own decisions and try to solve problems on their own or with the help of other students.

3. Curiosity and other intrinsic motivation: teachers can design learning experiences to encourage curiosity and do their best to motivate students, perhaps by linking theoretical discussions to practical examples and current situations.

4. Create: students feel creative when they create a product and present it. This does not necessarily have to be the classic academic products, but can also be innovative variants such as a blog, a website or a digital exhibition.

5. Multiple perspectives: a student is considered creative if he or she is able to take different perspectives and thus break out of patterns and prejudices. This can be achieved through the use of role-playing or perspective-taking techniques.

6. Imagining new ideas: the last facet of creativity in higher education is inventing new ideas and is related to the success of previous ideas. Creating new ideas is the key concept of creativity (Haertel et al. 2017; Jahnke et al., 2017).

2.5. Creativity in the new generation of students

The crucial role of creativity in the education system has been outlined in previous sections (McWilliam & Dawson, 2008; Hallman et al., 2016; Haertel et al., 2017; Jahnke et al., 2017). All educational sectors benefit from fostering creativity to support students' development, from preschool to their entry into the workforce (Wang & Murota, 2016; Patston et al., 2021; Grey & Morris, 2022). However, in recent decades, an increasingly sustainable combination of creativity, innovation and new technologies has developed worldwide (Susnea et al., 2014).

The educational context plays a crucial role in fostering creative and innovative skills, especially considering the increase in new media and technologies that students use in their daily lives. New technologies can be used in creative and innovative ways, contributing to informal education and learning (Beghetto, 2005; Ferrari, 2009). Today's students are growing up in a very different world than the generations before them (Susnea et al., 2014). To succeed in today's creative society, students must learn to think creatively, plan systematically, analyze critically, collaborate, communicate clearly and learn continuously (Resnick, 2014).

Unfortunately, most technologies in schools today do not support 21st century learning methods. In many cases, new technologies are merely applied to old teaching methods (Susnea et al., 2014). In addition, teachers struggle to engage students' interest and attention. Current and future cohorts of students are growing up surrounded by video games, smartphones and other digital media that have a major impact on young people's interest. This overwhelming proliferation of technology creates a large gap between the school and home digital environments, making the current educational framework perceived as inadequate. For all these reasons, it seems clear that creativity and innovation are indispensable prerequisites for the present and future of education (Beghetto, 2005; Ferrari, 2009).

2.5.1. Digital natives or digital students: the new ever-connected generation

On this premise, a new generation of students is emerging. Who are they? Who is the education system of the new millennium aimed at?

The term *digital native* was coined by Marc Prensky (2001), as opposed to what he himself called *digital immigrant*. Starting from the debate about the decline of education in the United States, Prensky notes one fact: the emergence of a new generation that has grown up with digital technologies and for whom tools such as computers, video games, music players and mobile phones are part of the everyday life that has always surrounded them (Prensky, 2001). According to the author, this radical change is one of the main reasons why the education system is no longer suitable for the new generation of students, also referred to by some as the Net-generation or Millennials (Smith et al., 2020). The term digital native refers to native proficiency in the digital language of computers, video

games and the internet. Digital immigrants, also called children of the book (Gutenberg natives), on the other hand, are those who have to go through a process of adaptation to the technological environment; for them, the digital language represents a second language that they have to learn (Prensky, 2001). Some of the differences between digital immigrants and digital natives relate to the different ways they approach knowledge and understanding (Sorrentino, 2018). Digital immigrants prefer to use the alphabetic code, learn in a linear way and through absorption, adopt a one-to-many communicative style, internalize the things they learn and recognize the primacy of authority over text. Digital natives, on the other hand, master the digital code, have a multitasking and active learning mode based on search and exploration, share and create knowledge, tend to externalize the learning process, value communication more than reflection, and do not ascribe sole authority to the text as multicodality is a characteristic of theirs (Prensky, 2001; Smith et al., 2020). For digital immigrants, the word virtual is often associated with a non-existent place, inevitably associated with deception and danger. For digital natives, on the other hand, the virtual is simply another manifestation of the real, with all the significant implications this has for their social relationships (Prensky, 2001). There is still much debate about the impossibility of defining the exact boundary between the generations of digital natives and digital immigrants: the transition was gradual, although some place the timing of the transition in 1985, a decision motivated by the proliferation of personal computers in developed countries. Others argue that the timing of the transition could be between 1996 and 2000, when the first internet browsers came on the market and the web began to spread (Smith et al., 2020; Evans & Robertson, 2020).

According to the study by Evans and Robertson (2020), four stages of development can be distinguished with regard to the phenomenon of digital natives:

1. in the first stage, Prensky (2001) disrupts society with the moral problem of the emergence of a new generation, the digital natives, who are highly technologically competent but are forced to be educated in an inadequate education system that is on the run.

2. in the second stage, studies show that a digital native is defined not so much by his age but by his level of education. It also becomes clear that digital natives' use of new technologies is not as developed and homogeneous as assumed (Smith et al., 2020). This reduces the pressure on the inadequacy of the school system.

3. in the third stage the focus shifts to the notion of digital students, who are considered on a continuum of access, ability, use and technological comfort. In this phase, the digital natives' ability to multitask is questioned, which, even when developed, affects attention and concentration.

4. in the fourth stage comes the modern *iGen generation*, a cohort born between 1995 and 2012 and characterized by the smartphone and the rise of social media (Twenge, 2017). According to

Twenge (2017), it is not so much the views that have changed for this generation, but the experiences they have on a daily basis. The number of hours spent on technological devices seems to be associated with problems related to psychological well-being, with the risk of depression and suicide.

Ultimately, much of Prensky's view has been tested and refuted in the literature over the past two decades, but recent studies of brain plasticity suggest that Prensky's idea that technology can change the way people learn is partially justified (Smith et al., 2020). However, it seems equally clear that not all of these changes are positive. For example, there is a growing body of research on the negative effects of multitasking and social media on learning and academic achievement (e.g. Moisala et al., 2016; Twenge, 2017).

However, there is more agreement on the definition of *digital students*, which replaces the terms digital natives, Generation Y, Net Generation, etc. (Bullen et al., 2011; Gurung & Rutledge, 2014; Creighton, 2018). This terminology, without creating a generation gap, takes into account the presence of digital technologies in daily life and the impact on learning experiences (Smith et al., 2020). Taking into account student characteristics and the speed at which they are changing allows education systems to be open to possible adaptations and modifications of curricula (Creighton, 2018). If, on the other hand, we settle for the stereotype of the digital native, to whom we ascribe innate digital skills, we risk losing valuable learning moments that we can offer to all students, regardless of their generation.

Technology plays an essential role in the teaching and learning of the younger generation, and its application in education is truly beneficial. Understanding how technological knowledge and skills are purposefully developed, rather than innate or possessed by students of a certain age, can help educators overcome stereotypes of digital natives by embedding digital literacies into broader curricula (Creighton, 2018; Smith et al., 2020; Evans & Robertson, 2020).

2.5.2. Measuring the creativity of digital students/digital natives

Whether one wants to call them digital natives or digital students, it is clear that the new generation is growing up with new technologies that were completely unknown until a few decades ago (Sorrentino, 2018; Creighton, 2018; Evans & Robertson, 2020). Therefore, one cannot pretend that change has not occurred and that it has not taken the education system and others by surprise (Smith et al., 2020). The new generation has new technologies and also requires a leap in technology for the educational context, school subjects and assessment of progress, including creative progress (Gurung & Rutledge, 2014; Creighton, 2018). The recognition that creativity has received in education in recent years (CEU, 2008; OECD, 2019; Grey & Morris, 2022) has raised the urgent need for large-scale assessment and training of this skill (Henriksen et al., 2018). Therefore, there is a need

to make assessment of creativity accessible to ensure an equitable education system that keeps pace with market demands (Henriksen et al., 2018; Rafner et al., 2022). Large-scale assessment can be enabled by the introduction of new technological tools that provide concrete opportunities to digitize the measurement of creativity in the classroom (Rafner et al., 2022). This consideration is even more valid considering that the use of new technologies is completely natural for digital students (Creighton, 2018).

Despite the premises about the usefulness of digital, almost all instruments used to assess creative potential in schools today are still old standardized tests (Henriksen et al., 2018).

Standard instruments have a number of features that sometimes complicate the assessment of creativity in the education system: they are often paper-based, were almost always developed in the middle of the last century, and are suitable for a different generation than that of today's students. They are also very time-consuming instruments in terms of human resources, as administration and evaluation require time-consuming, multiple observers, and there is a risk of subjective assessments (Rafner et al., 2022). So, while learning seems to be increasingly digitized, the assessment of creative potential remains rooted in old instruments (Chuang et al., 2015; Barbot, 2019).

However, assessing creativity using new technologies is one of the rapidly developing areas of research (Pásztor et al., 2015; Chuang et al., 2015). Thus, the inability to assess creative potential using digital tools is not due to a lack of new technologies or a lack of successful attempts in the literature (Chuang et al., 2015). For example, with the advent of digitization, various technologies, including mobile technology, have made it possible to transfer paper-based assessments to digital media. These tools have become increasingly popular over the past decade, offering expanded opportunities for large-scale testing, simplified data collection and monitoring of creativity in shorter time frames (Pásztor et al., 2015).

While there are digital tests that are proving to be very flexible, the use of the old standardized, universal, easy to understand and easy to find tests for creativity continues to predominate (Barbot, 2019). In the absence of digital tools that are easier to use, inexpensive and also widely available for daily use, it is difficult to think about how to systematically promote creativity in educational settings by monitoring the development of students' creative potential (Pásztor et al., 2015; Barbot, 2019).

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Chapter 3. Creativity and post-pandemic well-being in young people

The previous chapter described the construct of creativity, focusing on two theoretical models. The elements and gradient of creativity are fundamental to supporting its implementation in the educational context. Creativity, which already played a relevant role in all areas of individual and social development, has become even more important since the early 2020s. The spread of Covid-19 and the consequences of the pandemic have triggered a new wave of interest in the use of creativity for well-being. To better explain how creativity has become a resource and a cornerstone of recovery, it is necessary to briefly describe what has happened in the last two years and what the consequences have been.

3.1. The Covid-19 pandemic

In December 2019, a case of pneumonia was first reported in the city of Wuhan, China. The symptomatology of these patients was quite heterogeneous (Liu et al., 2020). In the most common cases, it was characterized by the presence of fever, cough, fatigue, headache and loss of taste and smell, but in the most severe cases it could lead to mobility disorders, speech deficits, confusional states, chest pain and severe respiratory illness with a high mortality rate (Di Fazio et al., 2022). The disease was initially named Wuhan pneumonia in the press due to its distribution area. Whole human genome sequencing revealed that it is a new strain of the coronavirus family that can infect humans (Liu et al., 2020).

On 12 January 2020, the World Health Organization (WHO) named the virus 2019 novel coronavirus (2019-nCoV) and officially renamed it *coronavirus disease 2019* (COVID -19) a month later. Subsequently, the International Committee on Taxonomy of Viruses (ICTV) officially designated the virus as SARS-CoV-2 (Liu et al., 2020), a highly contagious, mainly airborne viral pathogen that causes highly variable clinical symptomatology: it can be asymptomatic or lead to cases of severe pneumonia and other life-threatening conditions (Di Fazio et al., 2022; Bourdin et al., 2022).

From the appearance of the first symptoms in China, the Covid 19 virus developed within four months and spread rapidly to other countries in the world. The epidemic harnessed the forces of globalization and spread to more economically integrated urban areas (Bourdin et al., 2022). By early February 2019, several cases of Covid-19 had been reported across Europe. The first European fatality, which occurred in Italy on 21 February 2020, was quickly followed in all European countries (Mavragani, 2020). On 11 March 2020, Covid-19 was declared a pandemic by WHO, as had happened with the 1918 Spanish flu (H1N1), the 1957 Asian flu (H2N2), the 1968 Hong Kong flu (H3N2), and the 2009 pandemic flu (H1N1) (Liu et al., 2020). Italy was the first European country

to face serious problems and a large number of deaths due to Covid-19; shortly after, Spain, France, Germany and the United Kingdom faced similar, though not as severe, conditions (Mavragani, 2020).

Since March 2020, in an effort to slow the pandemic and flatten the contagion curve, governments have taken a number of non-medical measures at national and local levels (Mavragani, 2020; Bourdin et al., 2022). To limit the impact of Covid-19, states have taken more or less drastic measures, more or less staggered over time and based on different parameters. Before the production of the vaccine, the restrictions were mainly based on social distancing, travel restrictions and quarantine. The use of protective masks, personal hygiene and the disinfection of closed rooms were essential. In addition, travel, movement and public gatherings were banned and the interruption of non-essential services was ordered (IMF 2020; Mavragani, 2020; Di Fazio et al., 2022). The aim of these measures was to protect the health of the population and avoid overloading hospitals, especially intensive care units. As Bourdin et al. (2022) point out, managing the consequences of Covid-19 was complex and put a strain on health systems. Many European countries faced a real shock to the health system, which is why large geographical variations in the implementation of restrictive measures were observed (Flaxman et al., 2020; Bourdin et al., 2022).

Several studies have examined the effectiveness of social distancing measures and suspension of non-essential activities in combating the spread of Covid-19 (Flaxman et al., 2020; Bourdin et al., 2022). Lockdown periods have reduced the number of new cases in countries that have rigorously implemented this measure, particularly in Europe (Flaxman et al., 2020). At the end of 2020, a new phase of the pandemic was ushered in in Italy, as in the rest of Europe, with the start of the vaccination campaign. The use of the green pass, which could prove vaccination or a swab with a negative result within the last 48 hours, allowed people to move around again, travel, attend events and perform other daily activities, albeit with the help of masks. The validity of the green pass ended in March 2022. In the meantime, some Covid-19 variants have emerged, such as Delta and Omicron, which are less dangerous in terms of mortality but have a high prevalence even in younger people (Beccia et al., 2022). The COVID -19 pandemic has gradually affected countries around the world, and Italy has had the thankless task of being a pioneer in dealing with it (Beccia et al., 2022).

It has been more than two years since the World Health Organization announced that COVID -19 had assumed pandemic proportions. Since then, the disease has wreaked havoc around the world. By early March 2022, more than 6 million deaths had been reported and the European Union had suffered unprecedented economic damage (Heymann & Legido-Quigley, 2022). Experience over the past two years has shown that national responses to COVID -19 depend on several factors, including government approach, rapid coordination, well-organized scientific advice, resilient health systems and active community participation (Beccia et al., 2022; Heymann & Legido-Quigley, 2022). One

positive aspect of this biennium is innovation: in Europe as well as in North America and many other parts of the world, massive funding for research has quickly led to the development of new vaccines and diagnostic tests. These innovations have contributed to better control of the pandemic. There have also been several digital innovations, such as digital contact tracing through phone apps (Heymann & Legido-Quigley, 2022).

Since the start of the pandemic, 25,279,682 people have been infected in Europe alone, with about 185,417 people dying and 24,688,083 being cured. About 406,182 people are still infected every day[4].

3.1.1. The pandemic's impact on well-being

Previous studies of epidemics suggest that the pandemic and the measures needed to limit its spread pose a threat to mental health in addition to the specific risk to physical health (Balanzá-Martínez et al., 2020; Lau et al., 2020; Di Fazio et al., 2022). For example, following the outbreaks of 2003 (SARS-CoV-1) and 2012 (MERS-CoV), an increase in depressive and anxiety disorders as well as post-traumatic stress disorder was observed (Wirkner et al., 2022). COVID -19 classified as a multidimensional stressor is no exception. The pandemic and its consequences were global in nature and had a systemic impact on various sectors of society (e.g. economy, trade, entertainment industry). In addition, access to protective factors (e.g. sports, social events), including psychotherapeutic treatment, was restricted or blocked (Balanzá-Martínez et al., 2020; Di Fazio et al., 2022; Landi et al., 2022). Although containment measures were considered crucial to limit the spread of infection, they still had a significant impact on society and affected the mental health of the population (De Oliveira Araújo et al., 2020). Under these conditions, many sources of stress accumulated: from fear of becoming infected to fear of being responsible for spreading the infection among relatives, as well as prolonged isolation in quarantine, changes in living and working habits, feelings of loneliness and uncertainty about the future (De Oliveira Araújo et al., 2020; Di Fazio et al., 2022). Studies conducted during the pandemic showed that the period of isolation and the suspension of almost all activities outside the home had a negative impact on well-being (Balanzá-Martínez et al., 2020; Lau et al., 2020; De Oliveira Araújo et al., 2020).

One of the risk factors identified in most post-Covid 19 studies relates to young age or transition age. The statement also refers to school closures, which affect more than 1.6 billion youth and adolescents worldwide (Saulle et al., 2022). Restrictions also include the closure of recreational facilities and sports clubs, further limiting contact with peers (Wirkner et al., 2022). The restriction of social contact is particularly dangerous for mental health, especially for young people. Adolescence

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[4] https://statistichecoronavirus.it/continenti/coronavirus-europa/

is described as a time of increased vulnerability that can be particularly affected by restriction and isolation, as social contact and time spent with peers becomes even more important than staying at home with family during this developmental phase (Brown & Larson, 2009). Several studies point to the significant psychological stress experienced by children and adolescents during the two-year pandemic period (Ravens-Sieberer et al., 2021; Procaccia et al., 2022; Essadek et a., 2022). In particular, conflicts increased, learning became more difficult, quality of life was lower and psychological distress increased (Ravens-Sieberer et al., 2021; Procaccia et al., 2022; Essadek et a., 2022).

When we talk about young people being the most vulnerable, we are referring not only to adolescents but also to emerging adults, who are most affected by the psychological consequences of the pandemic. Between 2020 and 2021, data confirm that young adults are experiencing increasing levels of psychological distress (Procaccia et al., 2022; Essadek et al., 2022; Wirkner et al., 2022). This finding is supported by developmental psychology, which has always described the enormous importance of social contact with peers, increasing autonomy from parents, significant changes in social roles and instability of relationships in this age group (Sussman & Arnett, 2014). Italian studies (Di Fazio et al., 2022; Procaccia et al., 2022; Benedetto et al., 2022) have also confirmed the prevalence of anxiety symptoms, depression, changes related to daily routine and sleep-wake rhythm, problematic internet use, reduction in healthy exercise habits and changes in lifestyle and social contacts. These data mirror the findings of non-European studies that women experience greater psychological distress than their male counterparts (Di Fazio et al., 2022; Procaccia et al., 2022; Benedetto et al., 2022).

Since 2020, the literature has focused on risk factors and paid less attention to protective factors and resources that have emerged as a result of adaptation to the new historical context (Wirkner et al., 2022). Among these factors, more individual resources emerge such as resilience, coping strategies, self-esteem and self-efficacy, flexible thinking and curiosity, and others more related to relational aspects such as social support, feeling of being an active part of the community, solid ties with the family of origin (Landi et al., 2022; Singh et al., 2022; Lin et al., 2022; Pellerin et al., 2022). Some individual resources, such as flexibility, creative adaptation and coping strategies, bring us back to creativity and its role in post-pandemic society.

3.2. Creativity during the pandemic

Covid-19 caused an abrupt change in the lifestyles of populations around the world (Di Fazio et al., 2022). In some cases, however, individuals and countries have shown resilience and creativity in coping with the urgent demands of adapting to the new historical and cultural context. Creative action

can be an adaptive response to a changing environment and has been associated with individual and group well-being (Forgeard et al., 2014; Richards, 2007).

Over the last two years, everyday creativity (described as mini-c in section 2.3.2.) has been trained and improved. Engaging in creative daily activities may have been a means of coping with uncertainty and enabled people to find meaning in their daily lives (Kapoor & Kaufman, 2020). As the pandemic spread around the world, the stressful situation stimulated and motivated people to engage in creative activities. A genuine collective effort was initiated that sought out individual resources in everyday life to cope with the pandemic in creative and innovative ways (Cohen & Cromwell, 2021). It can be said that individuals felt the need to express or distract themselves by creating something (Kapoor & Kaufman, 2020). Creativity enables one to deal with uncertainty and endure the ambiguity of stressful situations, even if they are mini-actions that are not recognized as creative by anyone but oneself (Kornilova & Kornilov, 2010; Kapoor & Kaufman, 2020).

Several studies in the past have suggested using creative expression to better cope with stressful situations and achieve post-traumatic growth through artistic, literary and similar activities (e.g. Pennebaker, 1997; Forgeard et al., 2014). But the sharing of material produced and disseminated via the internet, especially video platforms and social networks, has led to a new strand of research on mini-c products created during the pandemic. An innovative way to engage in creative activities on a daily basis, even if only at home, that has been shown to be linked to improved well-being and coping with the pandemic (Kapoor & Kaufman, 2020). Build masks, find a way to make yeast, bread and pizza during the lockdown, or find alternative ways to exercise at home, perhaps via video call with friends. These and many other original ideas and actions were small mini-c products, some of which, through sharing on the internet, testified to the spread of creative thinking and its application to improve the well-being of individuals in different countries and at different times of the pandemic. Small creative acts, but with significant impact on daily life. Studies conducted during the lockdown confirmed an increase in daily creativity, especially among people with lower baseline creative activity and among students (Kapoor & Kaufman, 2020; Marciano, 2021; Brosowsky et al., 2022).

In short, people have experienced permanent changes that have disrupted their personal lives since the pandemic began. These changes require flexibility and adaptability as well as creative processes to develop alternatives and solve everyday problems. Creativity, flexibility and adaptability appear to play a crucial role in the relationships between resilience and the consequences of COVID -19 (Cohen & Cromwell, 2021).

3.2.1. Creativity and well-being during the pandemic

Studies show that creativity is one of the factors that has maintained well-being from the beginning of the pandemic to the present (Kapoor & Kaufman, 2020; Marciano, 2021; Mercier et al., 2021; Brosowsky et al., 2022). Daily engagement in creative activities and passing boredom as a normative experience have certainly contributed to the enhancement of well-being (Brosowsky et al., 2022). In this sense, creative activity enabled people to understand and cope with the uncertainty resulting from the pandemic by challenging old assumptions and experimenting with new possibilities. Uncertainty thus provided an opportunity for creativity to emerge (Mercier et al., 2021).

In addition to boredom and uncertainty, loneliness, a consequence of the isolation that characterized the pandemic, is also one of the factors associated with creativity. Loneliness has negative effects on physical and mental health, leading to increased anxiety, depression and unhealthy behaviors (Holt-Lunstad et al., 2015). However, according to some authors (Long & Averill, 2003; Mercier et al., 2021), it can enhance creativity. Indeed, solitude stimulates imagination, daydreaming and the capacity for wonder, while promoting self-reflection and contemplation, which are crucial for the adoption of new behaviours (Long et al., 2003; Mercier et al., 2021).

Creativity is therefore an important predictor of well-being, especially psychological and physical and relational well-being (Zhao et al., 2022; Brosowsky et al., 2022). When we talk about psychological and mental well-being, we refer not only to the absence of illness, but also to the individual's perceived valuation of his or her own life, health and mental functioning. Common factors of mental well-being include satisfaction, quality of life, affect, functionality, purpose in life and coping with stress. A state of well-being in which individuals are aware of their own abilities to cope with stressful periods in their lives (Zhao et al., 2022).

The study by Brosowsky and colleagues (2022), among others, shows that a person's tendency to engage more in creative daily activities compared to the pre-pandemic period is a strong predictor of better well-being. Indeed, it is possible that in the context of the pandemic, and given that extraordinary measures limited feelings of autonomy, engagement in creative activities promoted well-being by supporting feelings of agency and control (Brosowsky et al., 2022).

During the pandemic period, creativity also had a particular impact on coping strategies and resilience (Kapoor & Kaufman, 2020). This relationship was already known in the literature, as important links between creativity and the development of resilient behaviors in response to adversity had already been established before the pandemic (Metzl & Morrell, 2008). Equally well known was the role of creativity as a facilitative process in achieving post-traumatic growth (Kapoor & Kaufman, 2020). Prior to the spread of Covid-19, several studies had described the relationship between

creativity and resilience, both for their theoretical connections and as resources for individual well-being (Metzl & Morrell, 2008; McFadden & Basting, 2010).

On the one hand, psychological resilience is a mental armour against crisis situations that leads to good adaptation to contexts (Fletcher & Sarkar, 2013; Kapoor & Kaufman, 2020). At the same time, creativity generates adaptive responses to respond to new conditions and environments (e.g. Cohen, 2012; Kapoor & Kaufman, 2020). For this reason, the post-pandemic literature has highlighted the role of creativity as a potential protective and predictive factor for resilience at the individual and collective level, especially during times of particular stress (Verger et al., 2021).

Providing people with tools that enable them to be more creative strengthens their resilience so that people can better use their creative potential even in everyday activities (López-Aymes et al., 2020). Therefore, it can be argued that attributing meaning to events through any kind of creative expression is an adaptive and resilient response to the pandemic (Kapoor & Kaufman, 2020).

Orkibi's (2021) studies have highlighted the protective role of creativity in the daily pandemic, specifically talking about creative adaptation, i.e. the ability to respond creatively and adaptively to stressful situations (Orkibi, 2021; Orkibi et al., 2021). The study by Orkibi and colleagues (2021) specifically examined the role of creative adaptation as a predictor of social-emotional well-being (Orkibi et al. 2021). The results confirm that creative adaptation has an impact on the ability to cope with the imposing emotional impact that crises such as the pandemic can have on individuals.

3.3. Post-pandemic creativity: restarting from school

While creativity is an already familiar term in education, wellness is a relatively new addition that implies a number of health concerns for young people (Humes, 2011). In the last decade, wellness has become a priority in the education system due to a number of troubling indicators: teenage pregnancy rates, childhood obesity, adolescent alcohol and drug use, anorexia, self-harm and mental health problems (Humes, 2011; Barbot & Heuser, 2017). Valuing well-being in an educational context means recognising the importance of the affective dimension of learning: We do not learn only cognitively (Humes, 2011; Saulle et al., 2022). A student's ability to learn is shaped by their physical and mental health, relationships, family support and attitudes towards school (Gardner, 1993; Goleman, 1995). Such considerations of well-being in education became a focus of government policy and interest following the outbreak of the pandemic.

Since the early days of the release of COVID -19, experts have been concerned about the impact that the suspension of face-to-face and distance education would have on students (Grek & Landri, 2021). School closures not only risk significant learning losses, but also significantly widen pre-existing socio-economic educational gaps (Grek & Landri, 2021; Blaskó et al., 2022; Saulle et al.,

2022). In addition, the unequal distribution of resources in families has made it difficult for students to benefit equally from distance learning. The ability to take online courses was largely dependent on the availability of books, family learning support and the availability of technology at home (Blaskó et al., 2022; Ellis, 2022). Moreover, the transition of the school from a physical place to a virtual space revealed some weaknesses. The school community was not prepared for distance learning and digital use. Teachers and students had to learn very quickly how to use tools they were not familiar with and often encountered problems and difficulties in securing access to the necessary resources (European Commission, 2020; Palareti, 2020; Siakalli et al., 2022).

These difficulties in organizing distance education have become a source of stress for all stakeholders in the school system (Cowden et al., 2020; Palareti, 2020; Rabaglietti et al., 2021). The stress was particularly felt in some parts of Europe. In fact, schools in northern Europe had already introduced distance learning before the pandemic and had good technological resources. For this reason, they suffered less from students' lack of learning, in contrast to southern and eastern European countries, which had to improvise completely unprepared (Rabaglietti et al., 2021; Blaskó et al., 2022).

This new educational context created by the pandemic has focused attention on innovation and creativity (Siakalli et al., 2022). Flexible thinking, creative adaptability, problem solving and divergent thinking were all components that sustained the education system at a time when uncertainty and fear dominated the world stage (Grek & Landri, 2021).

A new surge of creativity came at a time when literature heralded a creative crisis (Grigorenko, 2019). Indeed, a decline in students' scores on creativity assessments had been evident for about a decade (Grigorenko, 2019). The push to teach creative rather than analytical thinking, to use new technologies creatively, and to promote creativity in schools at all grade levels is thus precisely a consequence of the post-pandemic recovery (Grigorenko, 2019; Siakalli et al., 2022). As was the case after the World War II, creativity is making a comeback with the help of new and digital technologies. Indeed, it seems that times of crisis are particularly conducive to the development of creativity, as they enable the overcoming of limitations and obstacles due to the historical context (Patston et al., 2021).

Inequalities in learning, creative blocks and pandemics urge us to take a proactive stance by developing Education 4.0. The content Education 4.0 focuses on includes interpersonal and technological skills, innovation and creative skills, in addition to digital citizenship (World Economic Forum, 2022). Throughout the pandemic, unconventional educational methods have enabled the implementation of innovative and creative methods by both teachers and students (Grek & Landri,

2021). Perhaps creativity played a key role in exploring these new learning methods in a different, digital, remote or hybrid educational context (Siakalli et al., 2022).

The pandemic has created a broader and more diverse learning environment for all, radically changing the way we teach, learn, interact and communicate (Grek & Landri, 2021). Teachers around the world have learned to use new technologies to present material to their students, communicate with their families and prepare lessons online. The pandemic has stimulated creativity in all areas and probably laid the foundation for new developments (Marciano, 2021). Henricksen and colleagues (2021) have commented extensively on the lack of an international common ground for systematising creativity in education. Perhaps the post-pandemic recovery is an ideal time to develop this common ground and review the role of creativity and promote it appropriately to support the development of the next generation (Marciano, 2021).

3.4. Adolescents and Young Adults during Covid-19

Adolescents, young adults and the elderly were the populations most affected by the consequences of Covid-19 in terms of physical and mental health (Rossi et al., 2021; Meherali et al., 2021). However, some studies have shown that older populations have lower levels of mental distress than younger counterparts due to their greater resilience (Rossi et al., 2021; Amicucci et al., 2021).

Adolescents and young adults, on the other hand, were more affected by the consequences of the pandemic, showed less resilience and were more prone to stress symptoms (Rossi et al., 2021). Given the central role that peers and social relationships play in this phase of life, it can be hypothesised that young people are particularly affected by social isolation and disengagement. In addition, limited opportunities to interact with others in the present have led to a pervasive increase in the use of digital devices during the day and especially at night, a deeply ingrained habit even before the pandemic. Increased screen use has been linked to problems related to sleep quality and duration, which in turn may have negatively impacted mental well-being (Amicucci et al., 2021). Several studies have shown that younger people in particular have higher levels of stress, anxiety and depression, also due to the profound disruption of daily routines (Amicucci et al., 2021; Meherali et al., 2021).

A study comparing the effects of Covid-19 with those of other pandemics found that stress, worry, helplessness, social and behavioural risk problems (such as substance abuse, suicide, relationship problems and school problems) were common in the youth population. However, this set of symptoms proved to be more significant during Covid-19 than in previous outbreaks (Meherali et al., 2021).

The condition of adolescents and young adults, known to be a vulnerable population, was already known before the pandemic (Binagwaho & Senga, 2021). In 2015, the mental health of children,

adolescents and young adults was recognized as one of the priorities of the Sustainable Development Goals (Radez et al., 2021). In fact, about 15% were already suffering from mental health problems such as depression, anxiety and behavioural disorders before the pandemic (Smith et al., 2020; Binagwaho & Senga, 2021; Magson et al., 2021). All untreated mental disorders before the onset of the pandemic developed or became chronic as a result of stress, isolation and altered living conditions during COVID-19 (Binagwaho & Senga, 2021; Magson et al., 2021). This widespread distress increased morbidity with other diseases and risk behaviours such as drug use, self-harm risk and suicide, the third leading cause of death among adolescents aged 15-19 years (Smith et al., 2020; Binagwaho & Senga, 2021).

To date, more than two years after the onset of the pandemic, several literature reviews report on the psychological distress and difficulties faced by youth, many of which remain unresolved (Panchal et al., 2021; Samji et al., 2022; Kauhanen et al., 2022). Resources, a starting point for providing young people with specific services, listening and support to resume activities after the pandemic, also emerge from these studies (Panchal et al., 2021; Samji et al., 2022; Kauhanen et al., 2022).

Social support, defined as the extent to which emotional and instrumental support is perceived in personal relationships, is one of the resources that support people in stressful situations (Ozbay et al., 2007). The pandemic COVID -19 has profoundly changed social life. Due to isolation, recent research has shown that university students in 2020 reported significantly lower levels of social connectedness than before the pandemic (Folk et al., 2020). In this context, social support, perceived as a protective factor, facilitates people's adaptation and is a resource for their resilience (Özmete & Pak, 2020).

Creativity also plays an important role as a resource for adolescents and young adults. Indeed, creative behaviours promote resilience (Metzl & Morrell, 2008), reduce stress, improve sense-making and support psychological well-being (Kapoor & Kaufman, 2020; Patston et al., 2021; Magson et al., 2021).

3.4.1. Adolescents and creativity

During adolescence, the physical, cognitive and affective developments that characterize this age lead to a search for a clearer and more concrete sense of self and identity (Beyers & Çok, 2008; Anderson, 2020). During this period, rapid maturation takes place at socio-emotional, cognitive and neurobiological levels (Barbot & Heuser, 2017). Not surprisingly, adolescence is often viewed by developmental theorists as a complex period with different levels and domains of criticality (Casey et al., 2010; Magson et al., 2021). This is partly due to physical and biological changes that lead to heightened emotionality in response to real and/or perceived stressors (Bailen et al. 2019). Another feature of adolescence is the marked increase in social sensitivity and peer importance (Anderson,

2020; Magson et al., 2021). Indeed, in order to achieve independence from the family of origin, the time spent with peers increases and they become the most important source of social interaction and influence (Meuwese et al. 2017; Magson et al., 2021).

This time of life is characterized by a major shift in identity development, intrinsically linked to the development of one's creative potential (Anderson, 2020). Identity formation itself, in fact, can be seen as a creative process through which adolescents can explore the many opportunities that the environment, external and internal, offers them. The process of identity formation thus understood involves exploratory processes, typical of divergent thinking, and integrates multiple elements, such as representations of the world, commitments, choices, and opinions, in order to formulate a personal, integrated, new product (Barbot & Heuser, 2017; Anderson, 2020). Indeed, although divergent thinking begins to develop very early in children, adolescence represents a new turning point in the development of this component of creative potential. This trend coincides with a relative increase in certain factors such as curiosity, complexity, or risk-taking, which seem to logically align with the context of adolescent identity formation (Barbot & Heuser, 2017; Anderson, 2020).

Creativity in adolescence is also related to self-expression, i.e. the expression of thoughts, ideas, feelings and emotions that can serve to externalise stress in conflict or stressful contexts (Anderson, 2020). Creativity can therefore be seen as a resilience mechanism to overcome the anxiety and stress associated with the normative but often stressful tasks of adolescent development (Barbot & Heuser, 2017). Adolescents can use creative activities as opportunities for adaptive self-expression (Anderson, 2020). In particular, creative-divergent thinking can enhance the process of identity exploration and formation by expanding what is perceived as possible and realising these possibilities in the adolescent's reality (Sica et al. 2019).

One of the most important roles of the adolescent is that of the learner. Therefore, the development of creative potential in adolescence is closely linked to the school experience. It is precisely the school context, together with reference adults and peers, that seeks to foster creative thinking in everyday activities, both school and extracurricular (Zaeske et al., 2022). This circumstance occurred especially during the pandemic, when the school system needed flexibility and innovation to continue teaching. Thus, the school context, almost unintentionally, became the main facilitator of creative experiences and divergent thinking for adolescents from different parts of the world (Zaeske et al., 2022).

Sica's (2022) study, conducted with Italian adolescents and young adults aged 18-21, confirms that the majority of students perceived creativity as a resource during the pandemic period. In particular, creativity was helpful in coping with difficult times, solving concrete problems, surviving periods of COVID-19 isolation and quarantine, expressing oneself, helping others and finding

meaning. These findings confirm that the use of creative activities can promote well-being in young people (Kapoor & Kaufman, 2020; Marciano, 2021; Mercier et al., 2021; Brosowsky et al., 2022). The pandemic period provided an unintended, applied example of how creativity can be used with young people to manage particularly stressful situations (Patston et al., 2021; Magson et al., 2021).

3.4.2. Young adults and creativity

The development of creative potential stimulated by the major changes in the adolescent period, persists into the first stage of adulthood, known as emerging adulthood (Anderson, 2020). This stage of development includes individuals from the ages of 19-20 years to around age 35, although the definition of this period by age is not entirely accurate. Instead, from a temporal perspective, young adulthood could be defined as the period beginning with the end of high school and ending with moving out of the parental home (Arnett, 2007).

From a psychosocial perspective, young adulthood faces some crucial challenges, such as graduating from high school, entering higher education or entering the world of work. The emerging adult devotes his energies to developing his own adult identity, which is also essential for building intimate and deep interpersonal bonds and finding his autonomy by detaching from the family of origin (Arnett, 2007; Sussman & Arnett, 2014; Sica et al., 2022). This process of identity formation becomes even more important in today's modern, liquid society, which implies a more flexible organization of life (Bauman, 2013). For these reasons, identity can be understood as a lengthy, open-ended process, often outside norms and standards and characterised by heterogeneous and diverse pathways (Kraus, 2007).

In this context of identity development, young adults express a variety of creative behaviours in their daily lives (Conner & Silvia, 2015; Zielińska, 2020; Karwowski et al., 2021). Furthermore, young people in this age group become more aware of their creative abilities and begin to perceive creativity as an essential aspect of the self (Karwowski et al., 2021; Sica & Sestito, 2021). As with adolescents, then, the relationship between creativity and well-being holds true. In particular, the ability to externalise psychological stress and discomfort through self-expression via creative activities (Anderson, 2020; Sica et al., 2019). At the same time, creativity can be understood as a resilience mechanism for coping with stressful events related to turning points, i.e. a particular episode or series of episodes that can change or redirect the course of one's life (Pillemer, 1998; Barbot & Heuser, 2017; Sica & Sestito, 2021; Sica, 2022). The lack of opportunities and interpersonal contact, as well as the lack of adequate support, have increased the prevalence of loneliness, depression and anxiety among young adults worldwide (Aristovnik et al., 2020; Elmer et al., 2020;

Kujawa et al., 2020). Thus, data confirm a significant decrease in life satisfaction and a significant increase in psychological distress compared to pre-pandemic levels (Preetz et al., 2021).

However, in the past two years, the literature on young adults has focused on mental health problems and neglected the resources that have emerged since the pandemic began. In addition, many of the studies used young adults as a convenience sample during the pandemic. However, this is often an unrepresentative sample with large age differences and individual differences (Peterson & Merunka, 2014; Hanel & Vione, 2016). Preference for this sample became a necessity during the pandemic: social isolation, disruption of educational activities and the impossibility of collecting data in person prevented the collection of data on younger populations, such as middle and high school students (Hanel, 2020). It is also true that this has led to a loss of attention to the specific characteristics of this age group, which has effectively prevented the implementation of targeted interventions. This would explain why they are still among the populations most affected by the consequences of the pandemic (Villalva et al., 2021; Ohannessian, 2021; Varma et al., 2021; Regnoli et al., 2022).

The considerations in this third chapter help to better understand the context of the last two years of the pandemic. Within this framework, the role of creativity in promoting the well-being of young people inside and outside educational institutions is described. Building on this shared knowledge, the second part of this paper describes the structure of the articles and their organization within the thesis.

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SECOND PART

Chapter 4. Methodology and organization of scientific papers

Each specific objective, as described in the first part of the thesis in section 1.3, has been addressed in a scientific paper. Specifically, these are three articles, one currently pubblished and two under review, in three scientific journals of international character relevant to SSD M- PSI /04: Frontiers in Public Health, Public Health Education and Promotion section, Thinking Skills and Creativity and International Journal of Modern Education and Computer Science.

In addition, as expected in the preface, the third study (Chapter 7) represents the least recent study in chronological order, whose development began before the pandemic and was further developed because it required paper-based, face-to-face data collection. Studies 1 and 2 (Chapter 5 and 6), on the other hand, grew out of the research topic, the creativity and consequences of the Covid-19 health emergency.

4.1. Methodology

The articles are all original research papers conducted using different methods.

For the first article, Chapter 5, a specific methodology for systematic reviews was used: PRISMA Statement 2020 (Preferred Reporting Items for Systematic reviews and Meta-Analyses) to ensure a transparent, accurate and comprehensive protocol for reviewing the literature on creativity and resilience since the pandemic outbreak (Maraolo, 2021). Due to the small number of articles found in the literature, it was eventually written as a mini-review.

The second article, Chapter 6, describes a cross-national, Italian-Spanish study whose data were collected through a bilingual self-report questionnaire distributed online through the Google Form platform to reach university students in the cities of Turin and Oviedo. Student's t, Pearson's bivariate correlation and two hierarchical multiple regression analyses were used to analyze the data. All analyses were conducted using SPSS 28 (IBM, 2021).

The third article, Chapter 7, presents the development of the prototype TCD-D mobile app for divergent thinking assessment and a study of the validity, reliability and sustainability of the tool conducted with university students. The development of the app, carried out at the University of Turin by the Department of Psychology in collaboration with the Department of Computer Science, followed the ADDIE design model, which is part of Instructional Systems Design (ISD). ADDIE is a model consisting of the phases of analysis, design, development, implementation and evaluation. In education, those involved in instructional design and training find this approach very useful as it facilitates the implementation of effective training tools by clearly defining the phases of tool development (Davis, 2013). Cronbach's alpha and Pearson's bivariate correlations were used to assess

validity and reliability, while for the sustainability study, the SUS scale developed by Brooke (1996) was used to understand users' problems in using the system.

All data collected in the studies ensure the protection of personal data guaranteed by specific legislation (Legislative Decrees 101/18, 679/2016, General Data Protection Regulation) and the researchers responsible for the research projects. Furthermore, all the studies were approved by the Bioethics Committee of the University of Turin on 15 April 2020 (as amended) under protocol number 157942.

4.2. Samples

All studies had adolescents and young adults as their target population.

For the first article, Chapter 5, the inclusion criteria included studies and research contributions that referred to a population of adolescents and young adults (age of the sample between 13 and 25 years), thus considering the age group that corresponds to high school and university students in Italy.

For the second article, Chapter 6, data collection took place only among university students, with a total of 314 participants, including 166 from the Italian region of Piedmont (University of Turin) and 148 from the Spanish region of Asturias (University of Oviedo). The average age of the total sample was 22.42 years (age range = 19-37 years). The majority of the total sample was female (n=123 Italian women; n=114 Spanish women).

For the third study, data were also collected exclusively from university students: 34 students from the University of Turin, including 32 women and only 2 men, with an average age of 22.47 years (age range = 21- 30 years).

4.3. Summary of contributions

The following is a brief summary of the studies that will be presented in Chapters 5, 6 and 7.

4.3.1. First Study

The first study analyzes the literature from January 2020 to understand which and how many studies have investigated the relationship between creativity and resilience in adolescents and young adults. Indeed, during this two-year period, the number of articles that have examined the impact of the pandemic on well-being and mental health, particularly among the most vulnerable populations, has increased significantly (Imran et al., 2020; Odriozola-González et al., 2020; Rider et al., 2021). In particular, the role of creativity and resilience as resources, already well known in the literature, has become even more important in the post-pandemic period (Orkibi et al., 2021; Tang et al., 2021; Michinov & Michinov, 2021). In this mini-review, we paid particular attention to how many articles actually refer to post-pandemic well-being. We also wanted to check which country had published

the most articles on this topic, which age group the studies were dedicated to, and which models, instruments and variables were considered. The screening selected only four articles (Fan et al., 2021; Zeng et al., 2021; Li et al., 2022; Prasittichok et al., 2022), of which only one actually addressed the consequences of the pandemic. All of the articles were published in Asian countries with a target population of university students; none of the studies referred to a population of secondary school students. Three of the articles used mediation models to examine the relationship between resilience as an independent variable and creativity as a dependent variable. All of the articles used self-assessment instruments for creativity and resilience, both at the individual and group level. This mini-review gives us the opportunity to reflect on the lack of studies that have addressed the issue of adolescent resources in the form of creativity and resilience since the beginning of the pandemic. Despite the enthusiasm of recent years and efforts to promote creativity, the results show us that interest is still underdeveloped in the scientific literature.

4.3.2. Second Study

The second study looks at the consequences of the pandemic for university students in Italy and Spain. Since the outbreak of the Covid 19 pandemic, several studies have described the severity, incidence and psychological distress of university students (Odriozola-González et al., 2020; Saulle et al., 2022), but little research has been conducted on resources and strengths. These include creativity and social support, both of which are strongly associated with resilient behaviors in response to adversity, reducing the negative impact of stress and facilitating adaptation after traumatic experiences (Oezmete & Pak, 2020; Nitschke et al., 2021; Cohen & Cromwell, 2021). The main objective of this cross-national study is to investigate any differences between Italian and Spanish university students regarding the relationship between creativity factors, social support and resilience, and whether creativity factors predict resilience differently in the two samples. 314 university students participated, 166 from Italy and 148 from Spain. The results showed that students in the two countries perceive support from different resources and use them differently to promote resilience. For Italian students, resilience is supported by the creative process along with relational resources. For Spanish students, on the other hand, only part of the creative process, the more relational component, along with social support, will support their resilience processes. These findings confirm previous studies (Fauziah et al., 2020; Karwowski et al., 2021; Mercier et al., 2021) that have assessed the role of creativity in promoting resilience in the post-pandemic period. However, the creativity factors that have the greatest impact on well-being are different in the two samples, with specific spillover effects in implementation in each of the two countries.

4.3.3. Third Study

The third study presents the development of the mobile application of the Test of Creativity and Divergent Thinking-Digital (TCD-D), a digital version of Williams' (1993, 1994) test for assessing creativity through graphic production. The TCD-D is a new, simple and intuitive mobile application developed by a team of psychologists and computer scientists to remain faithful to the paper version of the test, but to provide a faster and more up-to-date assessment of divergent thinking. Currently, creativity tests are still administered in paper form, which requires a lot of time and resources for scoring, especially when administered to large samples, as is the case with studies in education (Guo, 2016; 2019). In the last decade, several digital prototypes of creativity assessment instruments have been developed, some of which are derived from paper instruments and others are completely new (Kwon, et al., 1998; Zabramski et al., 2013; Pásztor et al., 2015). Of all these attempts, none has yet worked on a digital version of the Williams Test of Creativity and Divergent Thinking, although this instrument is widely used in Europe and Asia (Qian et al., 2010; Sica et al., 2019). Furthermore, of all the prototype digital tools in the literature, none was developed as a mobile application for tablets, a technology that is highly valued by the younger generation. The TCD-D app was developed to provide a faster and more contemporary assessment that takes into account the ease with which digital students engage with new technologies. Without changing the original indices of the paper test, some additional indices were also added to assess response time, processing time and number of erasures. The article explains how the application works and what future developments are planned for use in education. In addition, the study analyzes the reliability and validity of the divergent thinking factors (fluency, originality and elaboration) measured by the app using Cronbach's alpha and Pearson correlations. The validity is considered acceptable, especially considering the small number of subjects. Finally, the results of the sustainability study confirm the overwhelmingly positive judgment of the students.

4.4. Overview of the articles

Table 1 contains a brief description of chapters 5, 6 and 7, each consisting of one article.

Table 1. Overviews of the articles (Chapters 5, 6, 7)	
Chapter 5	Creativity and resilience: a mini-review on post-pandemic resources for adolescents and young adults

Aim	The literature review aims to examine the amount and types of articles published since the beginning of the pandemic (2020) to describe and explore the relationships between creativity and resilience in adolescents and young adults. Specifically: 1 - Assess how many articles have covered the topic of creativity and resilience in relation to the post-pandemic situation. 2 - Identify the geographical origin (country) of the publications dealing with creativity and resilience. 3 - Assess how many articles measured creativity and resilience with a target group of adolescents or young adults. 4 - Describe how the constructs of creativity and resilience and any other related variables were operationalized and evaluated.
Method	Systematic review conducted according to the PRISMA 2020 protocol. A keyword search of the Web of Science, PsycInfo, and Scopus electronic databases was conducted in April 2022, considering the publication period between January 2020 and April 2022.
Results	More than 1,000 articles from 2020-2022 were screened and only 4 studies met the inclusion criteria. All studies were published in Asian countries and included a sample of university students aged 16-25 years. Three of the articles used mediation models and one used descriptive analyses and correlations. All articles used self-assessment instruments for creativity and resilience, both at the individual and group level.
Journal	Frontiers in Public Health, section Public Health Education and Promotion, UNDER REVIEW
Chapter 6	Resilient university students in the post-pandemic era: the role of creativity and social support in a cross-national study
Aim	This cross-national study between two similar European realities, albeit with different characteristics such as Italy and Spain, aims to investigate possible differences between Italian and Spanish university students

	regarding the relationship between creativity factors, social support and resilience by assessing whether creativity factors predict resilience differently in the two samples, Italian and Spanish. Specifically:
	1 - Are there differences in creativity factors, social support and resilience between university students in Italy and Spain?
	2 - Is there a relationship between creativity factors, social support and resilience in the post-pandemic period in Italy and Spain?
	3 - Do creativity factors (personality attributes, divergent thinking and problem solving) under the control of social support predict resilience differently between Italian and Spanish university students in the post-pandemic period?
Method	Cross-national study of 314 students (166 Italian, 148 Spanish; mean age 22.43 years; 75% female).
	The following variables were measured: Creativity factors (creative personality, Gough, 1979; divergent thinking, Runco & Plucker, 2001; problem solving, Maydeu-Olivares et al., 2000), social support (Zimet et al., 1988) and resilience (Di Fabio & Palazzeschi, 2012; Notario-Pacheco et al., 2011).
	The statistical analyses used were: descriptive, Student's t, Pearson's bivariate correlations, hierarchical multiple regressions, performed with SPSS28.
Results	A difference between the samples emerges from the t-test and correlations: the resources used by Italian students are more individual (creative personality and divergent thinking) while for Spanish students they are more relationship-centered (social support and social problem solving).
	Hierarchical regressions describe the different predictive value of creativity for resilience, depending on the sample considered. Italian students use the entire creative process along with relational resources, while Spanish students use only part of the creative process, namely the more relational component along with social support.
Journal	Thinking Skills and Creativity, UNDER REVIEW

Chapter 7	Introducing TCD-D for creativity assessment: a mobile app for educational contexts
Aim	The development of the TCD-D, or Test of Creativity and Divergent Thinking, in digital form is intended to replicate and update the paper version of the Williams Test for measuring divergent thinking. Specifically: - Developing a prototype mobile application that automates the assessment of three indices of divergent thinking: Fluency, Originality and Elaboration. - Evaluate the reliability and reliability of the three measured indices of divergent thinking. - Evaluate the sustainability of the TCD-D mobile application with a sample of university students.
Method	The development of the TCD-D app was conducted through the ADDIE design model (Davis, 2013). Cronbach's alpha and Pearson's bivariate correlations were used to assess validity and reliability, while for the sustainability study, the SUS scale (Brooke, 1996) was used. The study was conducted with 34 students from the University of Turin (mean age 22.47 years; 95% women).
Results	The TCD-D app currently can automatically code three out of the five factors of divergent thinking (fluency, originality and elaboration), plus three additional indices (reaction time, completion time and the number of erasures). Cronbach's alpha, used to measure validity and reliability, was acceptable, especially given the small number of students who participated in the study. In addition, statistically significant correlations emerged between the indices measured through the test in the digital version (TCD-D) and the paper version (TCD). The sustainability study shows that students' rating of the app's usability is very high, even though many of them are not very familiar with the use of tablets as a mobile tool (Sauro & Lewis, 2016). Moreover, the use of the app is perceived as easy and intuitive and more stimulating than

	the paper version because it offers more visual cues, more features, and a greater sense of freedom of expression.
Journal	De Lorenzo, A., Nasso, A., Bono, V., & Rabaglietti, E. (2023). Introducing TCD-D for Creativity Assessment: A Mobile App for Educational Contexts. INTERNATIONAL JOURNAL OF MODERN EDUCATION AND COMPUTER SCIENCE, 1, 13-27.

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Chapter 5. Study 1

Creativity and resilience:
a mini-review on post-pandemic resources for adolescents and young adults

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Abstract

Two years after the outbreak of the pandemic, several studies look at the consequences for the well-being and mental health of young people. In particular, creativity and resilience are cited in the scientific literature as resources that promote this well-being in adolescents and young adults. This mini-literature review was created with the aim of examining how many articles have explored the relationship between creativity and resilience in adolescents and young adults since the onset of the pandemic. Particular attention was paid to how many of the articles actually related to the consequences of the pandemic, in which country they were published, their target population, and the models, instruments and variables used to analyze them. Only 4 articles emerged from the screening, of which only one was actually related to pandemic consequences. All articles were published in Asian countries with a target group of university students. Three of the articles used mediation models to examine the relationship between resilience as an independent variable and creativity as a dependent variable. All articles used self-assessment instruments for creativity and resilience, both at the individual and group level. This mini-review offers us the opportunity to reflect on the lack of studies that have addressed the issue of youth resources in the form of creativity and resilience since the beginning of the pandemic. The results show us a still underdeveloped interest in the scientific literature, contrary to what the media tells us.

1. Introduction

The pandemic COVID-19 represented a historical change caused by unforeseen events that people coped with without adequate psychological resources. Several studies (Balanzá-Martínezet

al., 2020; Imran et al., 2020; Odriozola-González et al., 2020; Rider et al., 2021) have shown that the consequences of the pandemic had a negative impact on well-being and mental health, especially among adolescents and young adults. The lack of opportunities, interpersonal contact and adequate support increased the incidence of loneliness, depression and anxiety (Elmer et al., 2020). Against this background, everyday creativity (also referred to as Mini-C in Kapoor & Kaufman, 2020) emerged as a protective factor that could be strengthened (Orkibi et al., 2021; Tang et al., 2021).

Creativity, defined as the human capacity to generate original, flexible and effective ideas, insights and solutions (Runco & Jaeger, 2012), appears to be an indispensable resource for managing change, generating invention and innovation, and meeting the challenges of our increasingly complex society (Kapoor & Kaufman, 2020). Numerous studies examining the role of creativity show that it facilitates individual adaptation and growth (Cohen, 2012; Forgeard, 2013), in part due to the flexibility by which it is characterised (Colombo et al., 2014). In the literature (Forgeard, 2013; Metzl & Morrell, 2008; Kapoor & Kaufman, 2020; Tedeschi & Calhoun, 2004), the increase in creativity that can follow a traumatic event is considered a true manifestation of post-traumatic growth. Several studies (Alfonso-Benlliure & Moral, 2022; Conner et al., 2018; Probst et al., 2019) further argue that creative thinking contributes to a person's well-being, self-actualization (Mohammadi & Asghari, 2020) and increased perceived control over problems in one's life (Alfonso-Benlliure et al., 2021). At the same time, creativity promotes self-confidence by providing opportunities for personal development (Alfonso-Benlliure & Moral, 2022; Ong et al., 2006). The COVID -19 pandemic and its consequences for daily life, schooling and work lead us to reconsider creativity within a unique historical period (Lopez-Persem et al., 2021). The few studies that have looked at creativity in the early phase of the pandemic suggest that the period of isolation fostered everyday creativity (Karwowski et al., 2021; Mercier et al., 2021) and that creative skills helped people become more resilient and better able to cope and improve their well-being (Michinov & Michinov, 2021; Orkibi, 2021).

Resilience is a dynamic developmental process that promotes positive adaptation to stressful, adverse and traumatic circumstances (Masten & Wright, 2010). Through resilience, individuals are able to attribute positive meaning to complex events, cope with negative emotions and adapt to external stressors that change throughout life (Xu et al., 2021). Factors that promote resilience include engaging in creative activities or developing creative potential (López-Aymes et al., 2020). Resilience and creativity involve personal and contextual components (Thomson, 2020). Resilient and creative people share personal characteristics such as flexibility, initiative, resourcefulness, adaptability, spontaneity and originality (Metzl & Morrell, 2008) and a number of contextual factors such as active ties to significant others, family support and the environment (Martínez & Lozano, 2010). Creative

and resilient people activate similar mental processes, such as adaptive cognition, i.e. thinking and action strategies that promote the well-being of self and others (Dunn, 2013), and emotional flexibility (Fredrickson et al., 2003), which enables resilient people to cope with critical situations by using humor, creative exploration and optimistic thinking. Literature in the last two years has highlighted the role of creativity as a potential protective factor for individual and group resilience during prolonged periods of isolation (Verger et al., 2021). Furthermore, providing people with tools to be more creative has been shown to strengthen their resilience, increase the number of resilient behaviors and the number of daily creative activities (López-Aymes et al., 2020). In addition, the interaction between creativity and resilience promotes the emergence of protective factors that support people to achieve positive outcomes even in adverse situations (Aydogdu et al., 2017; Kapoor & Kaufman, 2020).

After two years of the spread of COVID-19, young people are the most affected (Glowacz & Schmits, 2020; Huang & Zhao, 2020; Saulle et al., 2022). Several studies show that adolescents and young adults continue to have increasing levels of depression, anxiety and lower life satisfaction since the pandemic (Lattke et al., 2022; Mojtabai et al., 2016; Pierce et al., 2020). The data confirm a significant decline in life satisfaction and psychological well-being and a significant increase in mental health problems among adolescents compared to pre-pandemic levels (Preetz et al., 2021). Adolescence, and thus young adulthood, is characterized by intense biological, cognitive and psychosocial changes that have profound effects on the reorganization of identity and the development of creativity (Barbot & Heuser, 2017). At this stage of development, such identity reorganization can be seen as a creative process in itself, where adolescents and young adults explore multiple alternatives (and therefore participate in exploratory Divergent Thinking processes) and sometimes synthesize heterogeneous elements to formulate an integrated, new and socially adapted "product" (Barbot & Heuser, 2017). In a context of internal conflict and environmental pressures that generate stress, adolescents and young adults seek ways to find meaning and externalize their discomfort. Creativity can be seen as a kind of resilience mechanism to cope with anxiety and stress associated with the developmental tasks of adolescents and young adults (Barbot & Heuser, 2017). Therefore, promoting creative expression can be an effective way to frame these manifestations of stress in a more adaptive way (Barbot & Lubart, 2012).

Based on these theoretical premises, this literature review aims to examine the quantity and type of articles published since the onset of the pandemic (2020) to describe and explore the relationships between creativity and resilience in adolescents and young adults. Specific aims of the study are to:

1 - Assess how many articles have addressed creativity and resilience in relation to the post-pandemic situation

2 - Determine the geographic origin (country) of the publications dealing with creativity and resilience

3 - Assess how many articles have measured creativity and resilience with a target group of adolescents or young adults

4 - Describe how the constructs of creativity and resilience and any other related variables have been operationalized and assessed

2. Methods

2.1. Sources and Search Strategy

For this research, a specific methodology for systematic reviews was followed: the PRISMA 2020 Statement (Preferred Reporting Items for Systematic reviews and Meta-Analyses), so that a transparent, accurate and complete protocol could be ensured (Maraolo, 2021). In April 2022, a keyword search was conducted in the Web of Science, PsycInfo and Scopus electronic databases considering the publication period between January 2020 and April 2022. The search terms were ("creativ*" OR "creative thinking" OR "creative performance" OR "creative ability" OR "creative potential") AND ("undergraduate students" OR "college students" OR "university students" OR "secondary school" OR "high school" OR "higher school"). Additional parameters included only peer-reviewed, English-language journal articles. The search yielded 676 references in Web of Science, 34 references in PsycInfo and 447 references in Scopus, including 22 duplicates.

2.2. Study selection: inclusion and exclusion criteria

To better identify the articles, the PICOS model (Counsell, 1997) was used to determine the main characteristics of the studies to be included in the review. The search criteria for inclusion required that, in addition to being peer-reviewed and published in English, the articles (a) reported quantitative data, (b) referred to a population of adolescents and young adults (sample ages 13-25 years), (c) dealt with quantitative assessment of creativity and resilience with (d) outcomes on well-being, quality of life, and posttraumatic growth, and (e) were studies undertaken after the onset of the pandemic (December 2019). Instead, the exclusion criteria were the following: clinical population, Clinical cases, Single case, Clinical trials, Posters, Systematic reviews, Meta-analysis, Conference presentations, Letters to editors, Qualitative studies. The 1135 articles initially selected from the databases were transferred to the Rayyan program for screening, which was then performed by three independent reviewers. The article screening process that led to the selection is shown in Figure 1[5], schematized through a Flow Diagram according to the PRISMA 2020 Statement guidelines.

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[5] Figure 1 is presented in full dimension at pag 161 of appendix

Fig.1 The article screening process Flow Diagram according to the PRISMA 2020 Statement guidelines
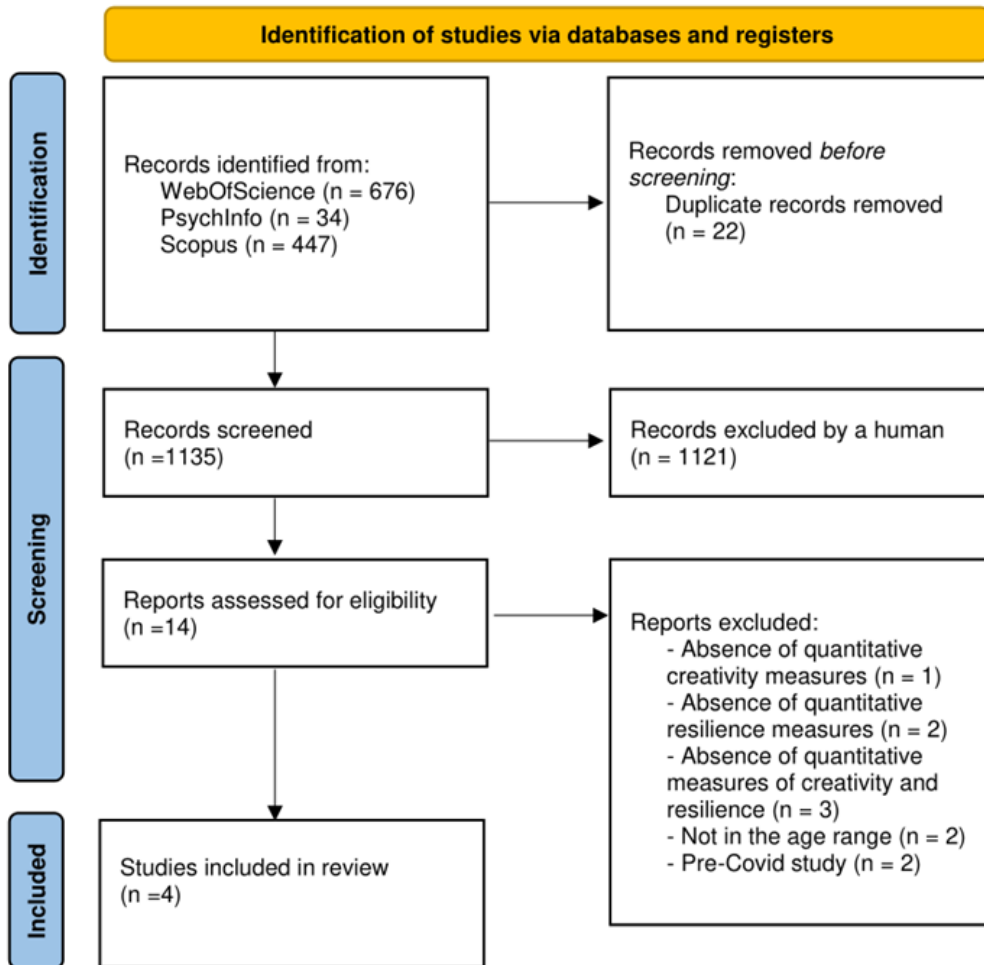
The characteristics of the final 4 articles included in the review are shown in Table 1[6].

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[6] Table 1 is presented in full dimension at pag 162 of appendix

Tab1. Characteristics of the final four articles included in the review

Authors	Titles	Years	Covid Publication	Geaographical area	Target sample	Models, Instruments and other variables
Fan, Cai & Jiang	Can team resilience boost team creativity among undergraduate students? A sequential mediation model of team creative efficacy and team trust.	2021	No	Mainland China	University students (no age)	Sequential mediation model; (IV)Resilience: Team Resilience Scale (Mallak,1998) (DV) Creativity: Team Creativity Scale (Rego et al., 2007) Other variables: (Me) team creative self-efficacy; team trust
Li, Liu, Yang, Du, Xie, Xiang, Duan & Hu	The influence of resilience on social creativity: Chain mediation effects of sense of humor and positive mood	2022	No	Northwest China	University students (16-21 y)	Sequential mediation model; (IV)Resilience: Resilience Scale for Chinese Adolescents (Hu & Gan, 2008) (DV) Creativity: Social Creative Questionnaire for University Students (SCQ; Hu & Yang, 2010). Other variables: (Me) sense of humor and positive mood
Prasittichok & Klaykaew	Meta-skills development needs assessment among undergraduate students.	2022	No	Bangkok	University students (18-25 y)	Description of desire and current states of meta skills; Resilience and Creativity: needs assessment Meta-skills scale (Kaufman, Rojas & Mayer,1993; Razzetti, 2018) Other variables: Self-Awareness
Zeng, Zeng, Xu, Huang, Shao, Wu, & Wu	The influence of post-traumatic growth on college students' creativity during the COVID-19 pandemic: the mediating role of general self-efficacy and the moderating role of deliberate rumination	2021	Yes	Guangdong Province, China	University students (no age)	Moderate mediation model; (IV) Resilience: Posttraumatic Growth Scale (Geng et al., 2011), (DV) Creativity: Runco Ideational Behaviour Scale (Runco et al., 2000) Other variables: (Me) self-efficacy (Mo) rumination

Note: IV= independent variable; DV= dependent variable; Me=mediator variable; Mo=moderator variable

3. Discussion

3.1. How many of the studies were actually conducted during the pandemic period?

Regarding the first objective of the study, only one of the four selected articles addressed creativity and resilience during the pandemic period. This was the study by Zeng and colleagues (2021), which was conducted in China between April and June 2020. Compared to the other three studies, this one has the exact date of data collection, which shows that the research was actually conducted during the pandemic. The lack of an exact date for the administration of the other articles, as well as the complete absence of any reference to the pandemic, lead us to believe that these may be studies conducted prior to the Covid outbreak, especially given the fact that they are studies conducted in Asia, a geographical area particularly affected by the virus. However, it is surprising that there are no other articles in the 2020-2022 biennium with the above inclusion criteria that measured the two variables in relation to the impact of the pandemic and the impact on the well-being and health of adolescents and young adults. Much of the literature that has examined the relationship between creativity and resilience in relation to the post-pandemic period has instead been devoted to socio-economic aspects with a target group of working adults (e.g. Anser et al., 2020; Oparah et al., 2021; Sappa & Barabasch, 2020). An obligatory consideration concerns research during the pandemic and the timing of publication of scientific papers. Indeed, during about half of the 2020s, social isolation and smart working made it difficult to initiate new studies and related data collection unless in an online format (Rashid & Yadav, 2020). This closure meant a drastic reduction in the number of

publications during this two-year period, as well as a shift on article topics; mostly focused on certain aspects of public health such as vaccine development, drugs/therapy and the emergence of a new workplace and work culture yet articles on psychological issues mostly began to be published almost a year after the onset of the pandemic, reason why it remains an under-researched area within the Covid context (Haleem et al., 2020).

3.2. Geographical area of publication: who was interested in creativity and resilience in the post-pandemic period?

Considering the second objective of the review, it appears that all the articles selected for this review are from Asia, particularly three from the northern and southern provinces of China and one from the city of Bangkok, Thailand. These data are partially consistent with the findings of Hernández-Torrano & Ibrayeva's (2020) review, which covered studies on creativity in education from 1975 to 2019. Their results, while specific to education, show that the three countries with the highest number of publications in these years are the United States, the United Kingdom and China. China thus has proven to be particularly active in research that deals with students and creativity. This is also confirmed by the number of publications on this topic during the last decade, which demonstrates the commitment of Asian countries in the concrete evaluation of policies and strategies to promote creativity in education (Chan & Yuen, 2014; Tan et al., 2022) at the industrial and economic levels (Jyoti & Dev, 2015; Shin et al., 2012). On the other hand, as far as the geographical distribution of resilience studies is concerned, to the authors' knowledge there is no data as precise as in the case of creativity. In Asian countries, however, the focus is mainly on the resilience aspects of the socioeconomic system and less on psychosocial well-being (as in Huang & Saxena, 2021).

3.3. The reference sample of the studies: adolescents or young adults?

Regarding the third objective of the review, the studies by Zeng and colleagues (2021) and Fan and colleagues (2021) were conducted with a sample of university students, but their age range is not specified. The study by Prasittichok and colleagues (2022), on the other hand, was conducted with university students aged 18 to 25, i.e. mostly late adolescents and young adults. According to the information in the articles, only the study by Li and colleagues (2022) was conducted with a sample consisting of adolescents and young adults, i.e. 16 to 21 years old, but who already belong to the university student group according to the Chinese education system. However, the studies by Fan and colleagues (2021) and Zeng and colleagues (2021) do not refer to the age group, but only to the membership of the sample in the university population, which we can therefore assume to contain a number of adolescents, as in the case of the study by Li and colleagues (2022). In general, it is possible to reflect more on the nature of the sampling than on the actual age group of the study participants.

In fact, all of the articles examine creativity and resilience in a sample of university students, a notoriously convenient sample that is readily available for scientific research. University students have always been a preferred sample for studies in the humanities, and especially in wellness and education, because they tend to be mature students. However, this is often an unrepresentative sample with wide variations in age and individual differences (Peterson & Merunka, 2014; Hanel & Vione, 2016). Preference for this sample became a necessity in the pandemic period (Hanel, 2020), in the USA (e.g. Browning et al., 2021), in Europe (e.g. Tavolacci et al., 2021) and in Asia (e.g. Luo et al., 2021) as social isolation, disruption of educational activities and the inability to collect data face-to-face added complexity to collecting of data on younger populations, such as middle and high school students.

3.4. Operationalization and evaluation of the constructs of creativity and resilience as well as other variables

In relation to the last objective of the review, all studies used self-reported instruments, and three of the four articles used mediating models where the direction of the relationship between creativity and resilience was the same: independent variable resilience and dependent variable creativity. In the study by Li and colleagues (2022), resilience was assessed using the Resilience Scale for Chinese Adolescents (Hu & Gan, 2008), while creativity was measured using the Social Creative Questionnaire for University Students (SCQ; Hu & Yang, 2010). Other variables that mediated the relationship between resilience and social creativity were sense of humor and positive mood. In the study by Zeng and colleagues (2021), resilience was measured by the construct of post-traumatic growth, using the Posttraumatic Growth Scale (Geng et al., 2011), while creativity was measured by the Runco Ideational Behaviour Scale (Runco et al., 2000). Self-efficacy was found to mediate the relationship between post-traumatic growth and creativity, while rumination took on the role of a moderator between self-efficacy and creativity. In the study by Fan and colleagues (2021), the constructs were considered in their social and especially in their team dimensions: thus, resilience was measured with Mallak's (1998) Team Resilience Scale and creativity with Rego and colleagues' (2007) Team Creativity Scale. Other variables considered to mediate the relationship between resilience and team creativity were team creative self-efficacy and team trust. Prasittichok & Klaykaew's (2022) study, unlike previous studies, pursued a descriptive goal regarding the desired and current states of meta-skills possessed by students. To this end, resilience and creativity, specifically problem solving, were measured using a needs assessment scale based on Kaufman, Rojas and Mayer's (1993) concept of meta-skills and one by Razzetti (2018). Another variable measured by the instrument was Self-Awareness.

4. Conclusion

Now, two years into the pandemic, it is not yet possible to predict how lockdown, social distancing and distance/hybrid education will affect young people's education, psychological well-being and mental health. However, it can be predicted that the consequences will be significant, especially for adolescents and young adults, who were particularly vulnerable populations during the crisis (de Araújo et al., 2020). Despite the fact that the last two years have been marked by particular media and academic attention to wealth-related resources such as creativity and resilience (Giovannini et al., 2020; Kapoor & Kaufman, 2020), there is still little relevant literature. This review, which screened more than 1,000 articles from 2020-2022, found only 4 studies on creativity and resilience in relation to adolescent and young adult well-being (Li et al., 2022). Of these studies, only one article actually linked creativity and resilience to covid-19 outcomes. It might be interesting to analyze whether the publication trend is the same for adults and what other resources with well-being have been studied in the last two years in relation to the consequences of a pandemic. All 4 articles were published by Asian research teams, particularly from regions in China and the city of Bangkok. Therefore, future studies could look internationally at which countries have published the most studies on creativity and resilience in the decade before the pandemic to learn more about pre-pandemic trends. In addition, it may be interesting to explore further studies that examine resilience in relation to psychosocial well-being outcomes over the same publication period, as suggested by other meta-analyses on this topic (Fan et al., 2021; Liu et al., 2020; Prasittichok & Klaykaew, 2022; Zeng et al., 2021). The entirety of the articles presents a sample of university students, but they look at an extended population of about 16 to 25 years old, i.e. adolescents and young adults. For these reasons, it would be interesting to examine well-being through resilience and creativity in adolescents more systematically during this post-pandemic period. Three of the studies use mediation models to analyze the relationship between resilience (VI) and creativity (VD), while only one describes the level of the two variables as perceived and desired. Although all 4 articles use self-assessment instruments, three of them consider resilience and creativity as individual variables and one as group/team variables. The other variables associated with creativity and resilience in these studies are: positive emotions, sense of humor, self-efficacy, rumination and self-perception. Future studies could explore which instruments are most commonly used to measure creativity and resilience, especially in the last decade, which has seen an increase in online data collection from young digital natives.

This mini-review gives us an opportunity to reflect on the lack of studies that have addressed the issue of youth resources in the form of creativity and resilience since the beginning of the pandemic. The results show us a still underdeveloped interest contrary to what we are told in the media. Much

remains to be said about the relationship between creativity and resilience and their contribution to young people's wellbeing.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

ADL, ER interpreted the data from the literature. ADL, ER wrote the original draft. ADL, LSL, ER reviewed, edited and drafted the manuscript, and approved the final version.

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Chapter 6. Study 2

Resilient university students in the post-pandemic era: the role of creativity and social support in a cross-national study

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Abstract

Since the outbreak of the Covid-19 pandemic, several articles have described the severity, frequency, and patterns of psychological distress in university students, but little research has been conducted on the resources that have emerged. These resources include creativity and social support, both of which have been strongly associated with resilient behaviours in response to adversity, reducing the negative effects of stress and facilitating adjustment after traumatic experiences. The main objective of this cross-national study is to investigate any differences between Italian and Spanish university students regarding the relationship between creativity factors, social support, and resilience, and to examine whether creativity factors predict resilience differently in the two samples. A total of 314 university students participated, 166 from Italy and 148 from Spain. Results show that students in the two countries perceive more support from various resources and use them differently to promote resilience. Italian students use the whole creative process (divergent thinking and problem-solving strategies), which together with relational resources support the resilience process. Spanish students, on the other hand, use only part of the creative process, the more relational component, problem solving, again in combination with social support, to achieve effective resilience processes. The findings shed light on the role of creativity in promoting resilience in the post-pandemic period, which manifests differently at some turning points in young adulthood in Italy and Spain. The authors hope that the results of this study will draw attention to the importance of creativity as a cross-curricular skill that supports positive development and lifelong learning.

1. Introduction

In the past two years, the pandemic known as COVID -19 has affected almost all aspects of economic, social and political life in all countries. Italy and Spain were among the most affected countries in Europe (European Centre for Disease Prevention and Control, 2022), which quickly introduced a series of legislative decrees to protect their health with a total lockdown. Several studies conducted during the pandemic (e.g., Aristovnik et al., 2020; Balanzá-Martínez et al., 2020; Elmer et al., 2020; Odriozola-González et al., 2020) showed that the lockdown and suspension of almost all activities had a significant negative impact on the well-being and mental health of the most vulnerable populations, especially university students. In fact, for adolescents and young adults, these unprecedented circumstances led to intense experiences of stress and promoted the emergence of anxiety in the face of the constant adjustments that the situation required (de Araújo et al., 2020; Saulle et al., 2022). Even before the pandemic, the frequency of emotional disturbances, anxiety symptoms, and depressive symptoms was higher in young adults, such as university students, than in adults and children (Odriozola-González et al., 2020; Saulle et al., 2022). The most characteristic and recurrent elements of the lockdown phase include uncertainty (Nitschke et al., 2020) and loneliness (Banerjee & Rai, 2020), both of which have been strongly associated with the development of creativity (Ford et al., 2008). Creativity may be a potential protective factor for individuals, as is interpersonal resilience during prolonged periods of isolation (Verger et al., 2021). Even before the Covid period, important connections between creativity and building resilient behaviours in response to adversity were noted in the literature (Metzl & Morrell, 2008). When people are empowered to be more creative, their resilience increases and they are better able to use their creative potential in everyday activities (López-Aymes et al., 2020). In fact, since the outbreak of the pandemic, everyday creativity (also referred to as Mini-C in Kapoor & Kaufman, 2020) and especially individual and social resources such as flexibility, divergent thinking, and problem-solving skills have been used to cope with the pandemic in everyday life in creative and innovative ways (Cohen & Cromwell, 2021). In addition, the role of creativity as a reinforcing process in post-traumatic growth has been recognised, as evidenced by the work of Forgeard (2013) and Kapoor & Kaufman (2020). The relevant role of social relationships as predictors and facilitators of resilience processes has also been suggested in the scientific literature by some post-pandemic studies, such as that of Nitschke and colleagues (2021). Specifically, social support can reduce the negative effects of stress and facilitate adaptation after traumatic experiences (Oezmete & Pak, 2020), including those that may occur in a pandemic context (Lardone et al., 2020). Based on these premises, there is still a dearth of studies that have examined the relationship between creativity and resilience in the post-pandemic period, particularly among university students as young adults. In light of this, the present study aims to

investigate, through a cross-national study, the relationships between social support, creatívity factors, and resilience in the post-pandemic period and, in particular, the differential predictive value of creativity factors in relation to resilience among university students from Italy and Spain, respectively.

1.1. Emerging adults: vulnerabilities during the pandemic period

Two years after the outbreak of the pandemic, it is not yet known how this period will affect education and overall mental health. However, it can be predicted that the consequences will be significant, especially for university students, as they are particularly vulnerable during the crisis period (de Araújo et al., 2020; Sahu, 2020). University students belong to the age group referred to as "emerging adulthood" (Arnett, 2000), a transitional period in life in which the phases of identity formation, career, and relationships are extended. This time is full of opportunity, but for some it is also a delicate and particularly turbulent time (Arnett, 2005). Studies of the physical health of young adults show that the effects of Covid-19 are less severe in this age group than in older adults, with a lower incidence of infection and death (Gambin et al., 2021). However, studies show that young adults are more likely to suffer from depression, anxiety, and lower life satisfaction than other age groups (Mojtabai et al., 2016; Pierce et al., 2020). Particularly in southern Europe, the physical effects of the virus are less severe in young adults, but the mental health consequences are greater compared with adults and older people (Elmer et al., 2020). The lack of opportunities and interpersonal contact, as well as the lack of adequate support, have increased the prevalence of loneliness, depression, and anxiety among young adults worldwide (Aristovnik et al., 2020; Elmer et al., 2020; Kujawa et al., 2020). Thus, data confirm a significant decline in life satisfaction among young adults and a significant increase in mental health problems compared with pre-pandemic levels (Preetz et al., 2021). However, the literature on young adults over the past two years has focused on mental health problems and neglected to examine resources that have emerged since the onset of the pandemic.

1.2. Fostering creativity during the pandemic crisis to support resilience

Creativity has always been an essential human capacity for managing change, invention, and innovation to meet the challenges of our increasingly complex society (Kapoor & Kaufman, 2020). Everyone's creativity, whether expressed in the form of personality attributes, divergent thinking, or problem-solving skills, is closely related to resilience because of the ability to generate diverse ideas, innovate, easily evolve, and, most importantly, adapt to the environment (Fauziah et al., 2020). Prior to the pandemic, several studies described the relationship between creativity and resilience. For example, Metzl and Morrell (2008) examined the links that exist at a theoretical level between the two constructs, focusing on practical implications in clinical and research settings, Fernández-Díaz

and colleagues (2021) highlighted the resource function covered by creativity and resilience, and McFadden & Basting (2010) examined the role of creativity in promoting resilience across the life course. The COVID -19 pandemic and its consequences for daily life, schooling, and work present challenges that undoubtedly lead us to rethink creativity in the context of a unique historical period (Lopez-Persem et al., 2021). The few studies that have looked at creativity in the early phase of the pandemic suggest that the period of isolation promoted everyday creativity (Karwowski et al., 2021; Mercier et al., 2021) and that creative skills helped people cope better and improve their well-being (Michinov & Michinov, 2021; Orkibi, 2021). However, there are few studies in the post-pandemic literature that examine the relationship between creativity and resilience. To our knowledge, there are no studies that have examined the predictive power of creativity factors on the resilience of university students in stressful situations, such as post-pandemic.

1.3. The effects of a missing network of relationships on resilience

Social isolation due to lockdown periods, has a negative impact on mental health due to drastic changes in the way people interact with each other (Elmer et al., 2020). Social support is one of the resources available to people to cope with life events perceived as stressful (Ozbay et al., 2007). The COVID -19 pandemic profoundly blocked and altered social life. Given the social constraints of the pandemic, recent research has shown that college students in 2020 reported significantly lower levels of social connectedness than before the pandemic (Folk et al., 2020). Social support, defined as the extent to which one perceives emotional and instrumental support in personal relationships (Ozbay et al., 2007), is also considered a protective factor. In this context, perceived social support is a factor that facilitates people's adaptation and is a resource for their resilience (Özmete & Pak, 2020). Despite these findings, there are few studies that have examined the relationship between social support and creativity. Most of them focus on worker well-being (e.g., Appu & Kumar Sia, 2015; Perry-Smith, 2006). Only a minority of studies have looked at young adults, confirming that social support contributes to increased creativity (Laguía et al., 2019; Tan et al., 2022). However, the literature is still lacking, especially for the post-pandemic period.

1.4. Italy and Spain: similarities and differences between two southern European countries

The acute pandemic phase was experienced in some European countries, such as Italy and Spain, with a number of similarities in timing and modalities. Not surprisingly, several comparative studies between the two countries have been published in the scientific literature to highlight common and unusual health and socioeconomic measures (Moreira et al., 2021). However, even before the pandemic, the two countries shared a number of sociocultural similarities, typically described in the literature as Southern European or Mediterranean (Papadopoulos & Roumpakis, 2020), characterised,

for example, by the central role of the family, but not always accompanied by the support of adequate policies, especially compared to Northern European countries (Jurado-Guerrero & Naldini, 2018). In terms of young adult education and youth policies, while Italy and Spain share some critical issues, such as the mismatch between higher education and labour market needs (Martínez-Campillo & Fernández-Santos, 2020), there are some significant differences, both in terms of educational pathways and the structure of higher education. In terms of access, in Italy, at the end of five years of compulsory secondary education (around the age of 14 to 18), it is possible to enter any tertiary education or to start working (European Commission, 2022a). In Spain, at the end of compulsory secondary education (around ages 12 to 16), students can either complete two years of vocational training to work or a two-year bachillerato to enter higher education (European Commission, 2022b). In terms of structure, the European Higher Education Area (EHEA) has given Europe a homogeneous, compatible, and flexible higher education system that allows for greater mobility of European students and graduates. In general, higher education degrees range from 180 to 240 ECTS (European Credit Transfer and Accumulation System). In Spain, bachelor's degrees have a value of 240 ECTS spread over four years, while master's degrees have a value between 60 and 120 ECTS spread over one or two years. In Italy, the value of bachelor's degrees is 180 ECTS distributed over three years, while the value of master's degrees is 120 ECTS distributed over two years. Because of this difference, university education paths differ in the two countries, affecting young adults' entry into the labour market and independence (Michavila Pitarch et al., 2015; Turri, 2016).

2. The present study

Many of the studies conducted since the beginning of the pandemic have focused on university students because they represent an easier sample to survey than younger students. These studies have focused primarily on describing the most common disorders and difficulties faced by this target population during the pandemic (Aristovnik et al., 2020; Gambin et al., 2021; Kujawa et al., 2020). Few studies have examined what resources occurred in university students during the pandemic (Krifa et al., 2022; Prowse et al., 2021). Most of these studies were conducted with university students from North America (Kujawa et al., 2020). Several comparative studies have examined student well-being and discomfort during university (Ochnik et al., 2021; Rogowska et al., 2021), but only a few have conducted comparative studies between European countries (Mana et al., 2021; Allen et al., 2022). Cross-national studies typically examine differences between Eastern (among them, China and Japan) and Western (America) countries (e.g., Moula, 2021). Less common are studies that compare countries with broad cultural similarities, such as countries in southern or northern Europe (Calandri et al., 2021; Canalda Criado, 2022). Even in the post-pandemic period, studies comparing countries

such as Italy and Spain are mostly socioeconomic or health-related (e.g., Faggioni et al., 2021; Núñez-Gil et al., 2021), and few address the mental well-being of vulnerable groups (Ruiz et la., 2021; Sandín et al., 2021). Moreover, to our knowledge, none of these studies have focused on the relationship between creativity and resilience in university students. Nevertheless, it is difficult to find studies in the literature that have examined the relationship between social support and resilience, taking into account the increasingly important role of creativity since the outbreak of the pandemic.

The main objective of this cross-national study is to investigate any differences between Italian and Spanish university students in the relationship between creativity factors, social support, and resilience (Fernández-Díaz et al., 2021; Özmete & Pak, 2020; Perry-Smith, 2006; Setyawati et al., 2019) and to examine whether creativity factors predict resilience differently in the two samples in the post-pandemic period. In summary, this study aimed to answer the following questions: (1) Are there differences in creativity factors, social support and resilience between university students in Italy and Spain?; (2) Is there a relationship, for Italy and Spain, between creativity factors, social support, and resilience in the post-pandemic period?; and (3) Do the studied creativity factors (personality attributes, divergent thinking, and problem solving), taking into account social support, differently predict the resilience of Italian and Spanish students in the post-pandemic period?

3.Method

3.1. Participants

A total of 314 university students participated, of which 166 from the Italian region of Piedmont (University of Torino) and 148 from the Spanish region of Asturias (University of Oviedo). The average age of the total sample was 22,42 years (age range = 19–37; *SD*= 2.87), 23,32 years for Italian (age range = 19–37; *SD*= 2.68) and 21,41 years for Spanish (age range = 19–37; *SD*= 2.75). The majority of the total sample were female (*n*=123 Italian female; *n*=114 Spanish female).

Figure 1 shows the descriptive data of the total sample in percentages.
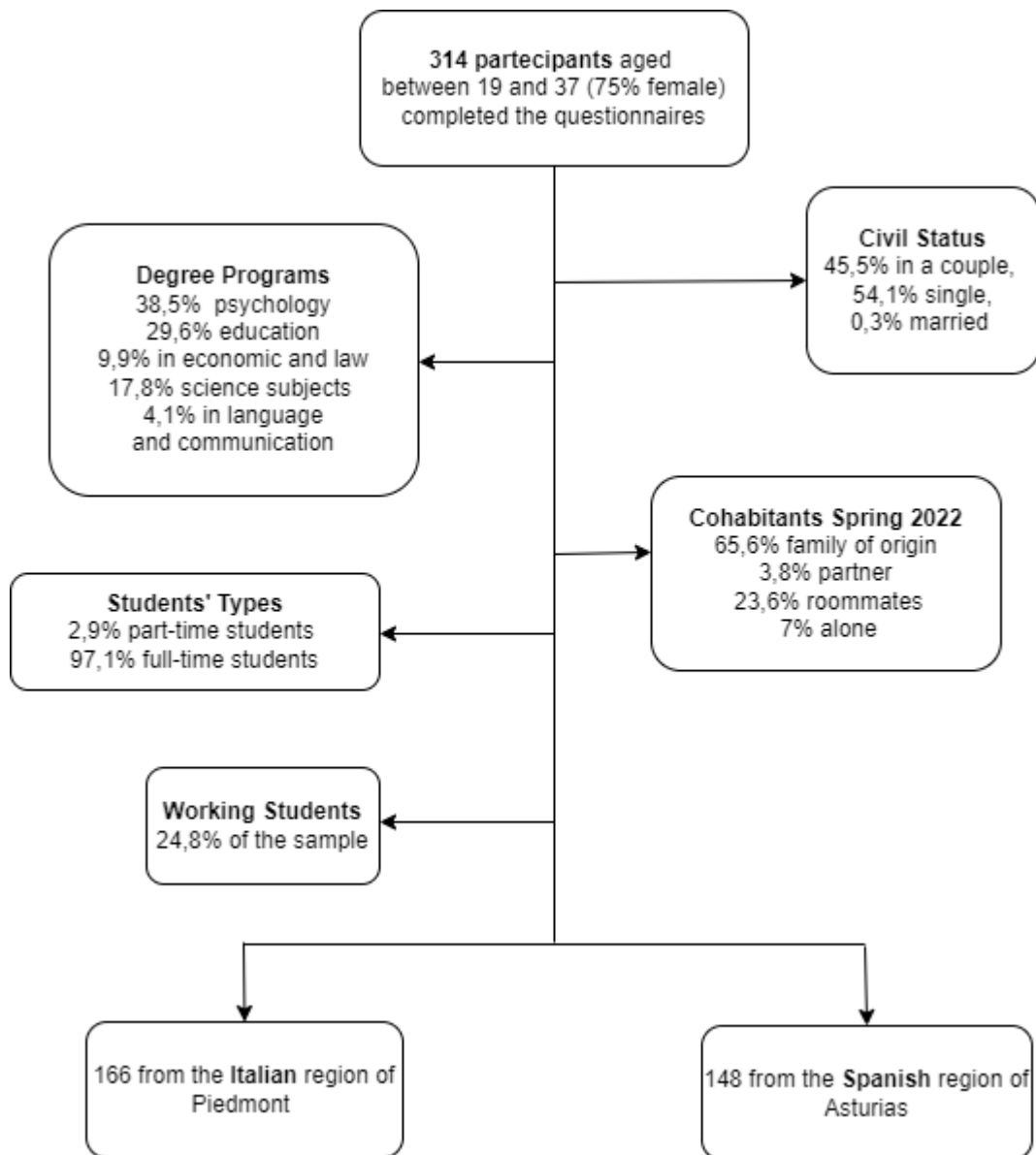
Figure 1. Descriptive data of the total sample in percentages

3.2. Procedure

Students completed an online questionnaire that collected sociodemographic data and the variables presented in the Measures section. The online distribution was done through the network of the Universities of Turin and Oviedo. The questionnaire was given to the participants in the spring of 2022. The study was conducted in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki), which reflects the ethical principles for research involving humans (Williams, 2008). After signing the informed consent form to participate in the study, participants voluntarily completed the questionnaire in a maximum of 25 minutes. All data were collected anonymously in accordance with research ethics regulations. The protection of personal data is guaranteed by specific legislation (Legislative Decrees 101/18, 679/2016, General Data Protection Regulation) and the researchers responsible for the research project. Furthermore, this

study was approved by the Bioethics Committee of the University of Turin on April 15, 2020 (and its later additions) under protocol number 157942.

3.3. Measure

All students involved in the study responded to an online questionnaire in Italian and Spanish. The questionnaire contained the validated scales for measuring the study variables and a section containing socio-demographic information such as gender, age, civil status, degree course, cohabitants during the pandemic and at the time of data collection. Data collection occurred in the spring of 2022. The dimensions considered in the study were: Creativity Factors, Social Support, and Resilience. Three scales were used to measure creativity factors: one on the person and specifically on creative personality attributes (Gough, 1979) and two on the creative process operationalized by divergent thinking (Runco & Plucker, 2001) and problem solving (Maydeu-Olivares et al., 2000).

3.3.1. Creative Person
Creative personality attributes

The Creative Personality Scale (CPS, Gough, 1979) has been used to measure creative personality attributes. It is a reliable scale that has several forms of validity and significant correlations with other measures of creativity (Gough, 1979). The CPS is a 30-item self-report scale that includes 18 positive and 12 negative attributes for creativity. Participants are asked to select all the attributes that best describe them. They receive 1 point for each positive attribute and -1 point for each negative attribute. The total score ranged from -12 to 18. The reliability of the Gough scale was calculated using a weighted composite procedure (Lord & Novick 1968). The 30 adjectives were divided into two subscales, a positive subscale and a negative subscale. Two Cronbach's reliability coefficients were calculated, one for each of these subscales (alpha+ and alpha-). Finally, the reliability of the overall Gough scale index was calculated using a linear combination weighted by the number of items from each subscale and the correlation between the subscales. In this study, the Cronbach's α value was .60, slightly lower than in other studies in which it was measured (Oldham & Cummings, 1996).

3.3.2. Creative Process
Divergent Thinking

The RIBS (Runco Ideational Behavior Scale) is a self-report assessment of creative ideas (López-Fernández et al., 2019; Runco & Plucker, 2001). It is called a behavioral scale because the items describe actual, overt behaviors that clearly reflect the person's use, appreciation, and ability in dealing with ideas (Runco & Plucker, 2001). Studies have shown that the RIBS is a useful criterion

for original and divergent thinking (Plucker et al., 2006). The short form consists of 23 items, of which subjects must indicate the frequency of occurrence of each on a scale from 1 (never) to 5 (very often). Runco et al. (2001) reported evidence of reliability and construct validity. In this study, as in other previous studies, the Cronbach's α value was .67.

Problem Solving

The Social Problem-Solving Inventory-Revised Short-Form (SPSI-RS; D'Zurilla et al., 2002; Maydeu-Olivares et al., 2000) is a 25-item self-report questionnaire that measures a person's cognitive, affective, and behavioral responses to real-world problem-solving situations. The measure consists of five subscales, two of which are considered adaptive and three of which are considered maladaptive: positive problem orientation (PPO) and rational problem-solving style (RPS), negative problem orientation (NPO), impulsive/inattentive style (ICS), and avoidance style (AS). Each item is rated on a 5-point Likert scale, and scores are calculated for each of these subscales. Higher scores on the NPO, ICS, and AS reflect a more maladaptive approach to problem solving, whereas higher scores on the PPO and RPS indicate more adaptive problem solving (D'Zurilla et al., 2002). In this study, as in other previous studies, Cronbach's α values were .69.

3.3.3. Relationship

Social Support

The Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988) is a validated scale consisting of 12 items that measures perceived support from family, friends, and partner. The items used to describe sources of social support in the MSPSS were designed to allow respondents to interpret and adapt the items to their own relationship situation (e.g., selecting a "special person"). The response mode includes a 7-point Likert scale (strongly disagree to strongly agree). Zimet et al. (1988) reported excellent psychometric properties, especially considering the number of items on the scale. In this study, as in other previous studies, the Cronbach's α-value was .91.

3.3.4. Resilience

The Connor Davidson Resilience Scale (CD-RISC; Connor & Davidson, 2003; Di Fabio & Palazzeschi, 2012; Notario-Pacheco et al., 2011) measures resilience and the ability to cope with adversity. The CD-RISC is a 10-item self-administered questionnaire designed as an additive Likert scale with five response options (0 = never; 4 = almost always). The final score of the questionnaire is the sum of the responses to each item (range 0-40), with the highest scores indicating the highest level of resilience. The original psychometric properties were good (Campbell-Sills & Stein, 2007). In this study, the Cronbach's α value was .84, as in other previous studies.

3.4. Data analysis

First, the means and standard deviations of each variable are presented for the total sample and the subsamples, with differences between the Italian and Spanish samples for all variables determined by a Student's t-test. Bivariate correlation analyses were then performed to determine the relationship between the variables. Finally, two hierarchical multiple regression analyses were performed to examine the predictive power of creativity factors on resilience, controlling for social support, in both the Italian and Spanish samples. All analyses were conducted using SPSS 28.

4. Results

4.1. Descriptive analysis and statistically significant differences between Italy and Spain in the study variables

Information on descriptive statistics for the total sample and sub-samples, Italian and Spanish (Table1)[7].

Table 1.

Descriptive statistics for Italian (n =166) and Spanish (n = 148) and the total sample

Variables	Sample	Min	Max	Mean	SD	Skewness	Kurtosis	t-score
Creative Personality Attribute	Total	-6	13	2.62	3.26	.45	.42	
	IT	-3	13	3.60	2.98	.65	1.00	5.96**
	ES	-6	11	1.51	3.21	.58	.25	
Divergent Thinking	Total	54	105	79.45	9.37	-.07	.07	
	IT	54	105	83.19	8.53	-.20	.49	8.25**
	ES	55	101	75.25	8.47	.02	.37	
Problem Solving -Positive	Total	1	20	10.80	3.62	.16	-.28	
	IT	2	20	10.83	3.58	.12	-.18	.11
	ES	1	20	10.78	3.66	.21	-.36	
Problem Solving -Negative	Total	0	20	9.37	4.47	.25	-.67	
	IT	0	20	9.31	4.37	.26	-.47	-.22
	ES	1	20	9.43	4.60	.23	-.86	
Problem Solving -Rational	Total	1	19	11.16	3.69	-.07	-.24	
	IT	2	19	11.15	3.60	-.11	-.27	-.06
	ES	1	19	11.17	3.79	-.03	-.20	
Problem Solving -Impulsive	Total	0	17	4.04	3.46	1.18	1.44	
	IT	0	17	3.63	3.69	1.48	2.21	-2.21*
	ES	0	15	4.50	3.14	.85	.63	
Problem Solving -Avoidant	Total	0	18	4.17	3.94	.94	.32	
	IT	0	15	3.31	3.44	1.14	.67	-4.17**
	ES	0	18	5.13	4.25	.69	-.05	
Social Support	Total	12	84	66.49	13.06	-.97	1.39	
	IT	23	84	64.27	12.25	-.49	.01	-3.24**
	ES	12	84	68.99	13.52	-1.56	3.50	
Resilience	Total	1	30	15.40	5.90	-.44	.33	
	IT	1	30	14.93	5.54	-.48	.60	-.89
	ES	2	30	15.93	6.93	-.44	.13	

Note. Total=Total sample (n=); IT =Italian Sample (n=); ES = Spanish Sample (n=);
All skewness smaller than 2 and all kurtosis smaller than 7 indicate a normal distribution, denoted by Kline (2013).
*p<0,05; **p<0,001

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[7] Table 1 is presented in full dimension at pag 163 of appendix

The mean scores for Creative personality attributes in the total sample and the two subsamples of this study are well below the mean scores obtained by Gough in his validation study (1979). In contrast, the Italian subsample achieves a higher mean compared to other recent studies (e.g., Park, 2013), while the Spanish subsample remains below the mean even in this case. Other studies, such as that of Luescher and colleagues (2019), have already highlighted the difference between the means of the cross-national samples and attributed considerable weight to cultural background in defining creative personality attributes. In contrast, the mean score of divergent thinking in this study (total and subsamples) is much higher than in recent studies with a target population of Southern European university students, as in De Prada and colleagues (2020). With respect to the different problem-solving styles measured in this study, both the total sample and the two subsamples have higher mean scores for the two positive scales (PPO and RPS) and lower mean scores for the negative scales (NPO, ICS, AS) compared to recent studies evaluating non-clinical samples in Europe, as in Van Horn & Wilpert (2017). Compared to the mean of the original study by Zimet (1988), the Spanish subsample in this study obtains a higher mean of social support, while the Italian subsample is slightly lower. In contrast, the mean scores of both subsamples in this study are higher than the mean score of social support analyzed in recent studies with college students, such as in Saputra & Palupi (2020). This result may indicate a trend that has led to a decline in social support over the past decade and was reversed by the pandemic events. The mean resilience of this study is significantly lower in the total sample and subsamples than in Italian and Spanish studies such as Di Fabio & Saklofske (2014) and Notario-Pacheco et al. This difference in resilience scores found in similar samples could be due to the pandemic period that frames this study.

Finally, to answer the first research question, the differences between the Italian and Spanish samples were analyzed in terms of the variables studied (Table1).

There were statistically significant differences between the Italian and Spanish samples: for Social Support (d=-0.36; 95% CI [-.59 -.14]), Impulsive Problem solving (d=-0.25; 95% CI [-.47 -.22]) and Avoidant Problem solving (d=-0.47; 95% CI [-.69 -.24]) were greater in the Spanish sample, whereas Creative personality attributes (d=0.67; 95% CI [.44 .90]) and Divergent Thinking (d=0.93; 95% CI [.69 1.16]) were greater in the Italian sample. There were no statistically significant differences between the Italian and Spanish samples for the other variables.

4.2. Correlations among variables

To answer the second research question and as a preliminary step to regression, Table 2[8] shows the linear correlations among the variables. The correlations are presented broken down by sample, IT and ES.

Table 2.

Pearson Correlations between variables analized

Variables	N	1.	2.	3.	4.	5.	6.	7.	8.
1.Creative Personality Attributes	IT								
	ES								
2.Divergent Thinking	IT	-.021							
	ES	.36**							
3.Problem Solving-Positive	IT	.00	.30**						
	ES	.28**	.52**						
4.Problem Solving-Negative	IT	.02	-.17*	-.46**					
	ES	-.24**	-.31**	-.32**					
5.Problem Solving-Rational	IT	.08	.36**	.46**	-.14				
	ES	.13	.41**	.58**	-.15				
6.Problem Solving-Impulsive	IT	.16*	-.05	.09	.23**	-.25**			
	ES	.11	-.04	.00	.28**	-.29**			
7.Problem Solving-Avoidant	IT	.06	-.09	-.33**	.46**	-.22**	.41**		
	ES	-.06	-.22**	-.48**	.44**	-.23**	.19*		
8.Social Support	IT	.06	.04	.29**	-.16*	.29**	-.18*	-.37**	
	ES	.21*	.21**	.24**	-.10	.07	.00	-.25**	
9.Resilience	IT	-.05	.32**	.64**	-.64**	.30**	-.04	-.36**	.30**
	ES	38**	.50**	.57**	-.61**	.37**	-.13	-.41**	.32**

Note: *p<0.05; **p<0.001
IT =Italian sample; ES = Spanish Sample

As found in other studies (Fernández-Díaz et al., 2021; Özmete & Pak, 2020; Setyawati et al., 2019), creativity, social support, and resilience are significantly correlated. However, unlike in the Spanish sample, in the Italian sample Creative personality attributes correlates only with Impulsive Problem solving (r = .165; p < 0.05), and Divergent Thinking does not correlate with Social Support (r = .043). Finally, Avoidant Problem solving does not significantly correlate with Social Support and Resilience in either sample (IT: r = -.009; ES: r =-.120). In both samples, there are no statistically significant correlations between age and resilience [IT (r=.076; p=.333); ES (r=.004; p=.959)] and between gender and resilience [IT (r=.110; p=.159); ES (r=.120; p=.145)].

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[8] Table 2 is presented in full dimension at pag 164 of appendix

4.3. Hierarchical Regression Models

To answer the third research question, two different three-stage hierarchical multiple regressions were performed, one for the Italian sample and one for the Spanish sample, with Resilience as the dependent variable. In the first stage of the regression, social support was included to control for the effects of the relationship aspect. In the second stage, the measure of the creative person, i.e., Creative personality attributes, was entered. In the third stage, the creative process was captured by the variables Divergent Thinking and four of the five problem-solving strategies. The independent variables of gender, age, and Impulsive Problem solving were not included in the models because they did not show significant correlations with the dependent variable of Resilience in any of the samples. The regression statistics are presented in Table 3[9] for the Italian and Spanish samples.

Table 3.

Summary of Hierarchical Regression Analysis for Variables predicting Resilience for Italian and Spanish sample

Models	Italian Sample					Spanish Sample				
Independent Variables	β	t	R^2_{adj}	ΔR^2	$F_{(gdl)}$	β	t	R^2_{adj}	ΔR^2	$F_{(gdl)}$
Step1										
Social Support	.30**	4.05	.08	.09	16.41** (1,164)	.32**	4.15	0.10	0.10	17.27** (1,146)
Step2										
Social Support	.30**	4.10	.08	.00	8.68** (2,163)	.25**	3.39	0.19	0.10	19.02** (2,145)
Creative Personality Attributes	-.07	-.98				.32**	4.32			
Step3										
Social Support	.12*	2.22	.57	.50	33.38** (7,158)	.16*	2.79	.58	.39	30.40** (7,140)
Creative Personality Attributes	-.05	-.99				.11	1.89			
Divergent Thinking	.12*	2.22				.12	1.85			
Problem Solving-Positive	.37**	5.64				.25*	3.15			
Problem Solving-Negative	-.44**	-7.08				-.43**	-6.96			
Problem Solving-Rational	.00	.04				.08	1.23			
Problem Solving-Avoidant	.02	.42				-.00	-.03			

Note. *p<.05; **p<.001

For both samples, the hierarchical multiple regression revealed that at Stage one, Social Support contributed to the regression model, [IT: F (1,164) = 16.41, p< .001; ES: F (1,146) = 17.27, p< .001] and accounted for about 9% of the variation in Resilience. Introducing the Creative personality attributes produces different outcomes, depending on the sample, in the second Stage. For the Italian model, Creative personality attributes didn't explain additional variation in Resilience (F (1,163) =8.68, p < .001). In contrast, for the Spanish model, Creative personality attributes explained an additional 10% of variation in Resilience (F (1,145) =19.02, p < .001). Adding Divergent Thinking

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[9] Table 3 is presented in full dimension at pag 165 of appendix

and different types of strategies of problem solving to the third stage explained an additional 50% of the variation in Resilience for the Italian model (F (1,158) = 33.38, p < .001) and 39% for the Spanish model (F (1,140) = 30.40, p < .001).

The most important predictor of Resilience in both models, controlling for Social Support, is the creative process, specifically positive and negative problem solving, which explains between 39% and 50% of the variation in resilience in the third model. In both samples, Creative personality attributes are fully mediated by the creative process. For Divergent Thinking, the samples' models differ: It is a significant predictor for the Italian sample, but not for the Spanish sample.

5. *Discussion*

Since the onset of the Covid-19 pandemic, several articles have described the severity, frequency, and patterns of psychological distress experienced by university students, rather than age groups (Aristovnik et al., 2020; Gambin et al., 2021; Kujawa et al., 2020). However, little research has been done on resources that have emerged in response to the pandemic. For example, the study by Prowse and colleagues (2021) addressed coping strategies, while Krifa and colleagues (2022) examined optimism. However, other resources, such as creativity and social support, remain unexplored in emerging adult populations. Moreover, since the outbreak of the pandemic, comparative studies between European countries have mainly addressed socioeconomic, health, and epidemiological aspects (Faggioni et al., 2021; Núñez-Gil et al., 2021; Saulle et al., 2022;) and only to a limited extent aspect of psycho-relational well-being (Ruiz et la., 2021; Sandín et al., 2021). This study was designed with the aim of analyzing the relationship between some of the resources of young adults in the post-pandemic period and assessing their predictive effect on resilience (Fernández-Díaz et al., 2021; Özmete & Pak, 2020; Setyawati et al., 2019). Specifically, the resources considered in the study fall under the factors of creativity, person and process, and social support as indicators of the goodness of relationships. This cross-national study examines this relationship in a sample of young adult university students from Italy and Spain, countries in Southern Europe that are culturally similar and experienced the pandemic period in a similar way. Finally, considering social support, the study analyzes the predictive value of different creativity factors (personality attributes, divergent thinking, and problem solving) for resilience, highlighting differences between subsamples.

Regarding our first objective, the fact that Italy and Spain coped with the pandemic in a similar way and at similar times is confirmed by the resilience, the extent of which does not differ between the two countries, both of which seem to be moving toward a phase of recovery and new adaptations (Faggioni et al., 2021; Núñez-Gil et al., 2021; Ruiz et la., 2021; Sandín et al., 2021). However, for the Italian sample, creativity seems to be the most important resource, especially as an individual

resource, while in Spain social support, a more relational aspect, plays a more important role, along with the use of problem-solving strategies aimed at circumventing the problem rather than solving it. It is known from the literature that creative personality attributes and social support are variables that are particularly correlated with culture of belonging (Luescher et al., 2019). In this case, being Southern European countries with a common cultural tradition (Jurado-Guerrero & Naldini, 2018; Papadopoulos & Roumpakis, 2020), no significant differences were expected. Contrary to assumptions, Italy and Spain differ in the type of resources most perceived by students: more individual in Italy and more relational in Spain.

In response to our second objective, we find different correlations between the variables in the two samples, especially with respect to creativity. Social support is positively correlated with resilience in both samples, as predicted in the literature (Özmete & Pak, 2020). From the results, it appears that the relationship between creativity factors and relationship aspects is stronger in the Spanish sample, while in Italy creativity remains a more individual resource. So far, the studies that have most investigated the relationship between creativity and relational aspects have mainly focused on the well-being of workers in organizations, i.e., a target group of adults (e.g., Appu & Kumar Sia, 2015; Perry-Smith, 2006;). However, recent studies of young adults confirm that creativity benefits from loneliness and may even be enhanced in circumstances characterized by poor social relationships, as in cases of social alienation that occurred during the pandemic (Karwowski et al., 2021; Mercier et al., 2021); however, other studies seem to show that social support enhances creativity (Laguía et al., 2019; Tan et al., 2022). This literature therefore seems to explain the two different types of associations found in the Italian and Spanish samples.

The results of the third objective illustrate the different predictive value of resources for resilience, depending on the sample considered. Students in the two countries perceive more support from various resources in the post-pandemic period and use them differently to promote resilience. Italian students use the entire creative process (divergent thinking and problem-solving strategies), which, along with relational resources, supports the resilience process. Spanish students, on the other hand, use only part of the creative process, namely the more relational component, problem solving, again in combination with social support, to achieve effective resilience processes. To the authors' knowledge, there are no pre- or post-pandemic studies that have jointly examined the predictive power of creativity and relational factors on resilience. Several studies (e.g., De Prada et al., 2020; De Lorenzo et al., 2021; Fernández-Díaz et al., 2021; Sica et al., 2019) show the interest of both countries in creativity and the desire to use this transversal capacity in different developmental contexts. However, the young adults who participated in the study are university students, so their perceptions are not only shaped by cultural background but also closely related to their country's

educational and university system. As the sociodemographic data show, most of the Italian students in this study live off campus (Dal Bianco et al., 2010). This means that the social network of these students has changed recently (Lau et al., 2013; Schudde, 2016). Distance from home, peer groups, and family could help explain the lower perceived social support of the Italian sample, even though the value of social relationships is one of the culturally defining factors in the literature for Southern European countries (Jurado-Guerrero & Naldini, 2018; Papadopoulos & Roumpakis, 2020). Moreover, the university system in Italy and Spain offers different pathways (European Commission, 2022a,b; Gobierno de España, 2022). At the time of the pandemic outbreak, almost the entire Italian sample was already in their first or second year of study, while their Spanish counterparts were completing their propaedeutic course. The Italian students had already been studying for three years at the time of the study and may therefore have been better able to cope with the creative process of adapting not only to the post-pandemic situation but also to the new stage of adult life, often far from their hometown. In contrast, the Spanish students who participated in the study at the beginning of their university careers, many of whom were still living with their family of origin, may have experienced more support from their social network, which facilitated resilience.

Based on these results, it is important to point out some limitations that came with this study, while still providing a good starting point for lines of research that will hopefully be explored further in the future. Beginning with the cross-sectional nature of the study, which did not allow for longitudinal analyses to further explore the directionality of these relationships with causal relationships. Future studies can examine the trend of the relationship between creativity, social support, and resilience to better explore how it changes and how to account for the developmental trajectories of young adults. The sample size of this study does not lend itself to conducting more detailed analyses, such as structural equation models (SEM). Future studies could encourage the participation of university students who are numerically representative of Italy and Spain, taking into account the profound cultural differences between the north and south of these countries, in order to obtain results that more accurately and generally describe not only differences between countries but also within countries. Ultimately, the measures used in this study are self-assessments that do not cover all possible facets of young adults' creativity and social network indicators. Therefore, while maintaining the dimensions considered, future studies might consider other, more descriptive or age-appropriate instruments to more accurately assess the intervention of sociodemographic variables.

6. Conclusion

To our knowledge, this is the first study to examine the impact of various creativity factors on the resilience of Southern European university students in the post-pandemic period, controlling for

the contribution of social support. The study contributes to the literature by examining how the relationship between creativity, social support, and resilience may take different forms among university students from similar cultural backgrounds. The findings shed light on the role of creativity in promoting resilience in the post-pandemic period, albeit with different manifestations during some turning points in Italian and Spanish emerging adulthood. The authors hope that the results of this study will draw attention to the importance of creativity as a cross-curricular skill that supports positive development and lifelong learning. Greater attention to the promotion of creativity in educational, school, and academic contexts could realistically support new adaptations, transitions, and a redefinition of adolescent and young adult identity in times of crisis such as we are currently experiencing.

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Chapter 7. Study 3

Introducing TCD-D for creativity assessment:
a mobile app for educational contexts

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Abstract

This paper presents the Test of Creativity and Divergent Thinking-Digital (TCD-D) mobile application, a digital version of the Williams Test for assessing creativity through graphic production. The Test of Creativity and Divergent Thinking-Digital is a new, simple and intuitive mobile application developed by a team of psychologists and computer scientists to remain faithful to the paper version of the test but to provide a faster assessment of divergent thinking. In fact, creativity assessment tests are currently still administered in paper form, which requires a lot of time and human resources for scoring, especially when administered to large samples, as is the case in educational studies. Several digital prototypes of creativity assessment instruments have been developed over the past decade, some of which are derived from paper instruments and some of which are completely new. Of all these attempts, no one has yet worked on a digital version of the Williams Test of Creativity and Divergent Thinking, although this instrument is widely used in Europe and Asia. Moreover, of all the prototypes of digital tools in the literature, none has been developed as a mobile app for tablets, a tool very close to the younger generation. The app was developed to provide a quicker and more contemporary assessment that accommodates the technological interests of digital natives through the use of touch in drawing and adds some additional indices to those of the paper

tool for assessing fluency, flexibility, originality and creative elaboration. The application for Android tablets speeds up the assessment of divergent thinking and supports the monitoring of creative potential in educational and learning contexts. The paper discusses how the application works, the preferences and opinions of the students who tested it, and the future developments planned for the implementation of the application.

Index Terms: Creativity, Divergent Thinking, Digital Natives, Mobile App, Education

1. Introduction

Creativity, defined as the ability to generate original, flexible, and effective ideas, insights, and solutions, has always been considered an essential human capacity to cope with change and demands of our (ever more) complex society [1]. Increasing the creative potential of individuals provides relevant implications for economic and social development [2]. In order to prepare young people for the new, increasingly involved and often technology-related problems they will encounter in the future, it is important that creativity is promoted as a transversal competence to be valued especially in the school context [3]. This is what has been happening since 1993 when the World Health Organization (WHO) included creativity within the Life Skills for the development and adaptation of the individual to the environment [4]. However, the promotion of creativity as a transversal competence is hindered by the difficulty of its assessment. Indeed, the currently existing tools for assessing creative potential apply with many difficulties to the educational context, either because they are too complex and difficult to assess, or simply because they are not freely available [2]. Moreover, the ability to use digital technologies is also seen as a fundamental skill in the 21st century, and this is also true with respect to creativity. Therefore, not surprisingly, the link between technology and creativity plays a key role in contemporary educational settings [5]. The continuing advancement of the digitization of our world and the growing demand for digital talent require changes in educational systems [6]. Digital tools and information and communication technologies (ICTs) in general, now within everyone's reach, offer new opportunities to manifest individual creativity as well as to assess and enhance it [7, 8]. The schools are required to support students in learning experiences that prepare them for the job market, since more than 60 percent of all jobs require a high level of critical thinking, creativity and interpersonal skills. In this context, there is a need for innovation for the future of education and digital approaches that play a significant role in supporting creative thinking [9]. The implementation of new technological tools in educational settings,

particularly for mobile devices, allows for the creation of a new learning environment that better supports creativity in school practice and provides concrete means to facilitate its assessment in the classroom [10]. This consideration is all the more valid when one considers that the use of new technologies is quite natural for the students of the new millennium, the so-called digital natives [11].

Despite these premises, almost all instruments used today to assess creative potential in schools and other institutions are still paper-based [12]. While learning appears to be increasingly digitized, assessment of creative potential still remains rooted in tools developed in the middle of the last century: paper tests, especially in the areas of drawing and graphic production [13]. The failure to assess creative potential using digital tools especially in education is not due to the lack of new technologies or the lack of attempts in the literature. With the advent of digitization, various technologies, including the mobile one, have enabled the transfer of paper exams to digital media. Such transfers have become increasingly important over the past decade, which has expanded opportunities for large-scale testing by simplifying data collection and monitoring creativity on a large scale, such as may be the case at the school or at the corporate level [13]. However, even with the improvements offered by new technologies for creativity, the old paper-and-pencil tests remain the most widely used forms because they are universally applicable, easy to understand, and readily available [14,15]. Still, the prevalence of paper-based tests that require in-person assessment, time-consuming coding, and high cost brings us back to a common consideration in the literature: in the absence of digital assessment tools that are easier to use, inexpensive, and available for daily use in educational settings, it is difficult to think of systematically promoting creativity in educational systems [16]. Indeed, it was not until the late 1990s that the first digital versions of creativity assessment instruments were developed, and few studies have addressed the potential of technological assessment of divergent thinking [14;17,18]. Most studies have used computerized versions of existing paper instruments for creativity assessment, as in the case of Kwon's Torrance Test of Creative Thinking (TCTT) [19], the e-WKCT, the instrument developed by Lau [17] based on Wallach-Kogan's creativity tests [20] or the computerized version of Torrance's TCTT [19] developed by Zabramski [15;21]. However, other authors have focused on developing new digital tools to assess creativity without relying on existing paper versions, as in the case of Palaniappan [18], who developed the Creativity Assessment System (CAS), or Putra and colleagues [22], who proposed a tool to automatically assess four factors of divergent thinking. The use of new approaches and models, as in the case of fuzzy theory [23], Scratch [19] and the use of neural networks [24], makes this branch of digital development of tools for measuring divergent thinking very interesting. However, all of the

previously mentioned tools were designed for personal computers and/or were accessible as dedicated web apps, without giving due consideration to the mobile app development that has happened in the last decade. Indeed, tools that are offered through mobile device apps represent one of the most useful and flexible digital technologies for application in instructional settings [25]. At present, most of the tools in digital version follow the model of the Torrance test [19], while there are no digitized versions of the test proposed by Williams [23], which is widely used, especially in educational settings, in countries such as Italy [26] and China [27]. Moreover, an assessment tool that can be used on an Android-based mobile device has not yet been created before, to the best of our knowledge. Within this respect, it is worth noting that Android is the most used mobile operating system worldwide, also due to the fact that it is open source.

For these reasons we implemented the TCD-D, or the Test of Creativity and divergent thinking, in digital form. The TCD-D comes from the paper version of the Williams Test, known as TCD [28] in Italy and as CAP [23] in the rest of the world. The overall aim of this study is to develop a prototype mobile app, called the TCD-D, which replicates and enhance the paper version of the Williams Test for measuring divergent thinking. In detail we:

- Develop a prototype mobile app that automates the assessment of three indices of divergent thinking: Fluency, Originality and Elaboration.
- Assess whether the three indices of divergent thinking measured by the TCD-D Mobile App actually measure fluency, originality and elaboration (construct validity).
- Evaluate the sustainability of the TCD-D Mobile App prototype with a sample of university students.

2. Literature review

2.1. Digital natives: the new generation of students between digitalization and creativity

The term "digital natives" refers to the generation that grew up with personal computers, video games, digital music players, video cameras, smartphones, and other modern technological devices [29]. According to Presnky [11], digital natives are really children of a new culture created by the aggressive intrusion of digital technology into the lives of young people born since 1980. A generation that has grown up in a technology-intensive environment where they move quickly, need instant feedback and are able to multitask, work in parallel and simultaneously on different tasks, and the use of digital technologies is fun and intuitive [30]. Much has also been said about digital natives about the differences in mindset from previous generations. Indeed, digital natives think differently because

they grew up in a different cultural context. Their thought processes have evolved differently, overstimulated by contexts rich in rapid interpersonal and communicative exchanges, most of which are mediated by new technologies [31]. Learning also takes place differently [32]. Already at the beginning of the new millennium, Prensky [11] expressed concerns about a school system that is not keeping up with the generation it is educating, and suggested thinking about forms of learning that emerge through games. Although criticized, game-based learning seems to be the preferred form of learning among young people, who especially appreciate the possibility of learning through gamification and the use of mobile devices available to everyone from childhood [33]. As a result of these reflections, a new educational approach has emerged in the literature that involves the intensive use of information and communication technologies (ICT) to improve students' skills and new methods of active learning, such as Serious Games and Blended Learning (face-to-face learning and computer-based learning) [34]. According to the NACCCE framework, creativity and new forms of digital learning have a reciprocal relationship: creative processes enhance learning with new technologies, and conversely, digital learning enhances creative thinking [34]. Therefore creativity, the foundation of learning and knowledge, is becoming increasingly digital and technological and its educational value is ever more present in the daily experiences of the new generations. In recent years, more research has been done to examine the intersection of these two trends that combine creativity and technology in education [7;35,36].

2.2. Divergent Thinking: theory and tools for education

Creativity is one of the most talked about 21st century skills in education, and one of the most frequently stated goals of modern education systems is precisely the development and nurturing of creativity in students of all ages [16]. There are several approaches to the study of creativity in the literature that focus on different factors, such as studies that consider process, people, product, and environmental influences [1]. Particularly important in educational contexts is the study of the creative process, which is the sequence of thoughts and actions that lead to new adaptive productions [37] and that manifest in different ways, not all of which can be assessed. To capture this process, the literature refers to divergent thinking, i.e., the ability to develop multiple solutions in response to a given stimulus or problem [2], and this is thought to be one of the thought processes underlying creative performance [1]. Although divergent thinking is only one component of the creative process, it is considered a predictive indicator of creative potential from an educational perspective [38,39]. Divergent thinking is a way to train students to produce knowledge, seek ideas and solutions to a

problem. In addition, the creative process has been shown to promote critical thinking, self-motivation, and student mastery of skills and concepts [7]. Divergent thinking was originally derived from Guilford's Structure of Intellect model [40] and stands as a process that produces numerous answers, in contrast to convergent thinking, where only one or a few correct solutions are possible, as in traditional intelligence tests [16].

Divergent thinking is one of the areas of creativity for which the absolute most assessment instruments have been developed [2]. Some of the earliest instruments developed for measurement in the middle of the last century are still among the most widely used, such as Guilford's Structure of the Intellect (SOI) Divergent-Production Tests [40], Torrance's Tests of Creative Thinking (TTCT) [19], and Wallach and Kogan's [20] and Getzel and Jackson's [41] DT test. Some assessment tools for divergent thinking have also become popular because of their cross-cultural invariance, such as tests of graphic production. These can be more easily adapted and used anywhere in the world without the risk of cultural bias due to the almost complete absence of a verbal component (except for instructions) [42,43]. Among the tests for divergent thinking, the Torrance test is the one that is currently still most widely used, discussed, and adapted in the literature [44, 45, 46, 47]. The Torrance test is based on Guilford's theoretical formulation and includes four main factors for measuring divergent thinking: fluency, flexibility, originality, and elaboration. In general, these four factors are common to almost all tests that assess divergent thinking by measuring it in graphical or verbal form [38]. The same four indices are used, for example, in the design protocols of Williams' Creative Assessment Packet [2]. Like Guilford [40] and Torrance [19], Williams [23] developed a test to assess divergent thinking and, in particular, cognitive factors related to creative behaviors. This instrument was developed specifically for the educational context with the goal of making teachers more aware of the development of their students' creative potential. Similar to the Torrance test [19], the CAP consists of a verbal section, a questionnaire, and a graphic section, i.e., drawings elicited by completing a graphic stimulus [23]. In contrast to the Torrance test [19], which is mainly used in the USA, the CAP enjoys great popularity in the East, especially in China [27; 48, 49] and Taiwan [48; 50], and in some European countries such as Italy [51, 52, 53, 26] where it is known as the Test of Creativity and Divergent Thinking (TCD) [28].

2.3. Digital Assessment for creativity

Assessment based on new technologies is one of the most rapidly developing areas of research in educational practice [54]. This growing attention is due to the advantages of digital assessment, such

as online test administration, automatic scoring, increased accuracy, objectivity, reliability, and the possibility of immediate feedback [16]. Computer-based techniques allow creativity data to be collected and analyzed using a single system. In addition, digital assessment can reduce the time and manpower required to calculate results and provide feedback by decreasing the margin of error. Finally, the flexibility of digitized exams allows examinees to participate in an exam anytime, anywhere, without the need for the examiner to be physically present [54]. It is important to remember that examinees in the school system are students who belong to the generation of digital natives and who use digital tools for leisure as well as for learning and working [33]. Despite all the advantages that new technologies bring to the assessment of creativity, there are still some critical issues, such as the need to ensure hardware stability and software compatibility, considering the rapid innovations that change the tools used [54]. In the specific case of measuring divergent thinking, test administration and paper scoring are among the main problems. Open-ended tasks generate ambiguities that are difficult to deal with in traditional paper-and-pencil test administration, where each protocol must be coded manually. Due to these and other problems already listed, the process of data analysis is time consuming and cannot be effectively implemented in daily school practice, especially with the intention of systemic evaluation [16]. In 1998, Kwon developed a computerized version of the Torrance Test of Creative Thinking [19]. While the instrument was attractive because it allowed for rapid computation of data, it did not work well because the use of the mouse was problematic and negatively affected drawing performance. Lau [17] developed a computer-based assessment instrument called e-WKCT in 2010 based on Wallach-Kogan's creativity tests [20]. In this case, the paper and digital versions were comparable, but the computerized version had the advantage of being easier to administer and score. They also used an automated scoring system and conducted a large-scale study of 2476 elementary and secondary students. The instrument allowed for immediate feedback upon completion of the test and online comparison of scores with Hong Kong norms. Palaniappan [18] developed a web-based intelligent creativity assessment system (CAS) in which verbal responses were automatically scored based on the manual database of the TTCT. In cases where responses could not be identified or did not fit into a category due to their novelty, the system sent them to a website where the researcher had to categorize them manually. Zabramski [15;21] also developed a computerized version of Torrance's TCTT [19]. The two versions, paper and digital, were found to be comparable. In addition, the graphical user interface (GUI) was examined and three different input methods (mouse, pen, and touch) were compared. However, in the last decade, new technologies related to the mobile world, gamification, and virtual reality techniques have emerged,

further diversifying the development of new digitized forms of creativity assessment tools. In the study by Chuang and colleagues [54], a digitized and gamified version of Williams' CAP [23] was developed using fuzzy theory. However, this is a computerized version that does not replicate the paper test, which consists only of graphical productions, but creates a game interface that engages users with challenges, assessments, and entertainment. This digital version does not measure originality and title attribution, an additional index that is almost always considered in the case of graphic productions. Instead, Pásztor and colleagues [16] developed an online divergent thinking measurement tool comprising nine tasks based on Torrance's [19] and Wallach and Kogan's [20] open-ended divergent thinking item types. The tasks were computer-based, specifically three alternative-use tasks, three list-completion tasks, and three graphing tasks. Kovalkov and colleagues [55], inspired by the Torrance test [19], measure divergent thinking (specifically, originality, fluency, and flexibility) by developing an instrument that uses Scratch, a visual programming environment designed for open-ended and creative learning. The use of Scratch is particularly attractive for automatic assessment of results and also allows the instrument to be more applicable to educational settings and students. In their study, Putra and colleagues [22] propose an automated assessment tool that is not based on a paper test but is able to objectively measure the four factors of divergent thinking without lengthy programming. The software development process follows the waterfall model. This automated assessment tool, which encodes divergent thinking by assessing digital storytelling images, can be a practical solution to support students' creative thinking skills in computer programming. Another very recent study by Cropley and Marrone [24] has instead used neural networks to create a digital tool capable of automatically evaluating the creative figure of Torrance's TCTT. This approach has achieved excellent results in terms of accuracy and speed through the application of machine learning and has shown that it is possible to remove the barriers that currently make graphical production testing impractical. These are just a few of the studies that have investigated the development of digital tools to support creativity assessment in recent years. In addition to focusing on divergent thinking, some have also looked at digitizing tools for assessing problem solving [56], and still others have looked at the feasibility of studies using such digital tools to assess creativity [57]. Thus, this is a rapidly evolving literature that produces interesting technological innovations for the application of creativity.

3. Methodology

This study uses the ADDIE design model, which is part of Instructional Systems Design (ISD). ADDIE is a model consisting of the phases of Analysis, Design, Development, Implementation and Evaluation [58]. However, this sequence does not have to be followed according to a rigid linear sequence of steps, that is, the phases can be interleaved. Educators and those involved in design and training find this approach very useful as it facilitates the implementation of effective training tools by clearly defining the phases. As an ISD model, ADDIE has been widely accepted and used [58]. We tackled the five development phases in the following way (Figure 1):

- *Analysis*: in order to define the requirements for the digital implementation of the TCD, we started by observing a certain number of tests on paper, to outline which features to implement and also to understand which additional features could be added to the digital version. It was also important to find out what could be appealing for young children. In particular, this led to the choice of using (Android-based) tablets as digital supports.

- *Design*: by keeping in mind the target of the users, we decided to limit the number of buttons. Each visual component is simple and colorful, with soft shapes. Each button has an image associated with it, evocative of its function (for instance, a pencil for writing). There are also easy-to-read tutorials for each TCD test, explaining the usage of the buttons. A further goal of the application is to calculate and present the results in a readable and easily analyzable format for the examiners, and this was also taken into account in the Design phase.

● *Development*: the goal was to make the digital version not only as close as possible to the paper one, but to make it even better. The trickiest part was to position and make the various components interact in the correct way. Another important issue was the storage of the results, in order to make them accessible and readable by the examiners.

● *Implementation*: the application was implemented as a desktop tablet application, in order to test it first on a limited group of users. We plan to make it a web app in the future.

● *Evaluation*: we started to design some *usability tests*. The usability is both from the point of view of the students and from the point of view of the examiners.
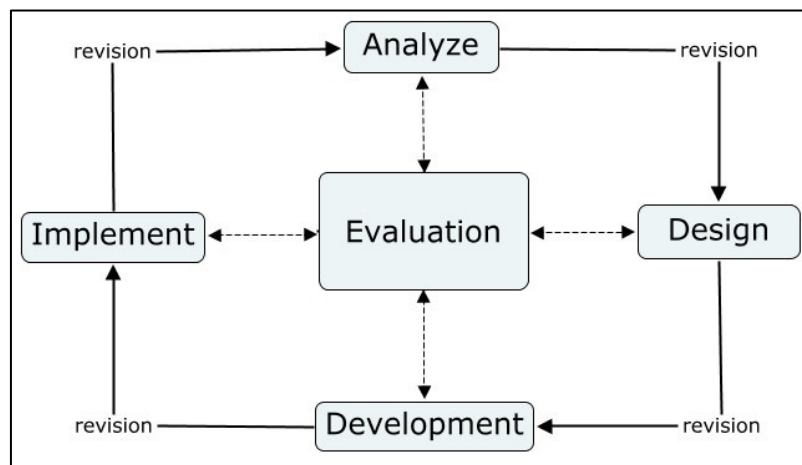

Fig.1 ADDIE Model

The ADDIE model is useful when working on a project with a multidisciplinary team, i.e., where the members have different expertise, therefore they are not always experts in all the development phases of the prototype, as it is in this case. In particular, the flexibility of this model allows team members to go back and improve a development phase at any time after comparing notes.

In a nutshell, this paper is about the development of a prototype TCD-D app for Android tablets that facilitates the assessment of divergent thinking according to the Williams' model, starting from the paper version of the Creativity and Divergent Thinking Test (also known as the Creative Assessment Packet). The app makes divergent thinking to be assessed digitally, facilitating remote data collection and automating the assessment of three of the five indices. After the development, the prototype of the app was evaluated with respect to usability and effectiveness. The study obtained Ethics approval from the University Bioethics Committee, Prot. n. 157942.

4. Design and Implementation

The Test of Creativity and Divergent Thinking - Digital (TCD-D) is a mobile application that is easy to install, does not require any manual settings from the users, and allows them to save test results anonymously and in a place safe from unauthorized access. The development of the application followed the design model ADDIE [58], part of the Instructional Systems Design (ISD), that is a series of practices for the development of teaching material in paper or digital format.

Exactly as in its paper version, the TCD-D assesses divergent thinking through two protocols (A and B), each of which involves the completion of 12 frames. Each frame presents an incomplete graphic stimulus to be incorporated into the graphic production. The drawing produced in each frame is evaluated through five factors: four graphic factors (*fluidity, flexibility, originality, elaboration*) and one of verbal production (*attribution of a title*).

1 Fluency: this is the amount of graphic production that is produced by counting the number of completed frames.

2 Flexibility: it depends on the number of times the user changes category from the first frame. There are five categories: Living Beings, Mechanical Devices, Symbols, Views, Useful Things.

3 Originality: it is calculated based on where the design is placed, i.e., inside, outside or both in relation to the graphic stimulus.

4 Elaboration: it is measured by the symmetry or asymmetry of the design within the frame.

5 Title: it is measured by the addition of descriptors or abstract references.

The TCD-D app presents a first simple screen (Fig. 2[10]) where the user can login and enable some features: in particular, the color palette and the automatic saving of the test outputs (through Internet connection). The examiner, based on the sample, the purpose of the test and the availability of a wi-fi connection, decides whether or not to enable the buttons. The access credentials consist of alphanumeric codes that can be changed according to the purpose of use.

After logging in, the user will be able to choose, with the guidance of the examiner, the protocol to be performed: protocol A is the main one, while protocol B, equivalent to the first, is used in the case of longitudinal studies or repeated evaluations, to avoid proposing already known graphic stimuli.

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[10] All the app screens are in Italian, the language in which TCD-D was developed.
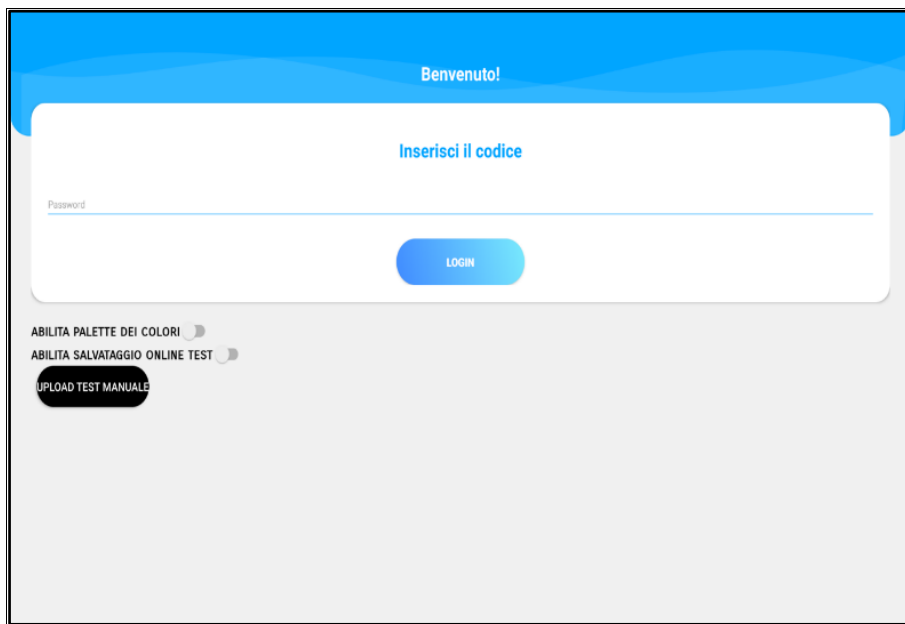
Fig.2 Login screen

Once the protocol is selected to be completed, the user is prompted to enter their date of birth and gender. These are optional information, yet useful for the purpose of assessing divergent thinking. At this point, users receive instructions for completing the test. The text of the instructions has been reproduced exactly from the paper version of the Williams test [28]. By confirming that one has read the general instructions, the first frame of the protocol is accessible. Before starting the drawing session, the use of each button is illustrated with a brief explanation (Fig. 3). The general instructions and the detailed explanations of the buttons are the only verbalized parts of the test.
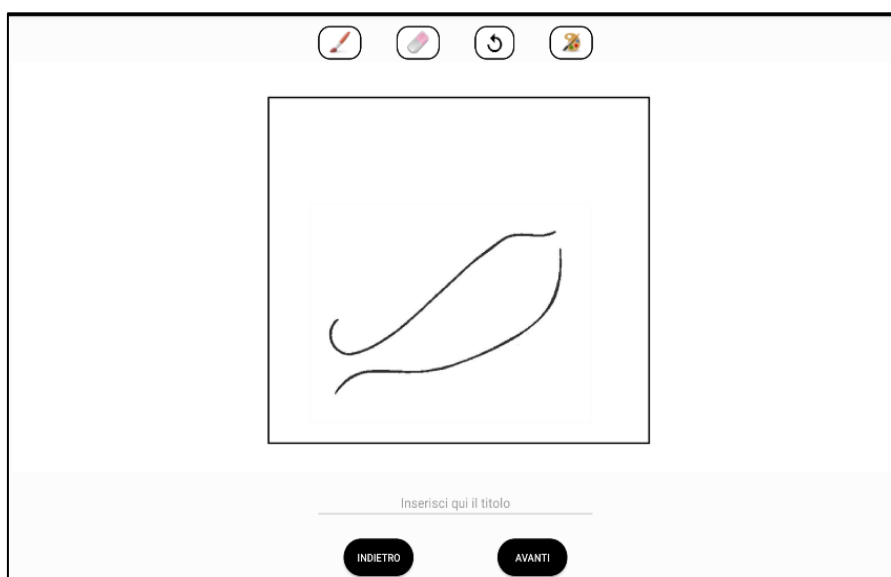
Fig.3 Drawing screen as for the paper test with tools

The buttons available to the user, from left to right, are:

- *Pencil tool*: this button enables the drawing by touch of graphic signs in the dedicated area inside the frame.

- *Eraser Tool*: this button enables the erasing of the strokes drawn, by touch again.

- *Undo Tool*: this button is related to an addition with respect to the paper version and is therefore exclusive to the digital version; it allows the user to automatically erase the last segment created, for faster and more precise results.

- *Color Palette*: this is optional and can be enabled when opening the app. It gives the possibility to use 8 primary colors. In the paper version the subjects are free to use the colors because it is not an assessment element. In the implementation of the app, the use of color is not counted as an additional index, but it is possible to choose to make it available or not to the users based on the type of assessment (for example, in the case of children, the use of color can represent a distraction from the task).

- The *FORWARD* and *BACK* buttons are used to move from one frame to another in the protocol, with the option to return to a frame that was left undone previously.

- The *text area* is used to give a title to each frame. Clicking on the text area automatically opens the keyboard of the tablet, giving each user the possibility of attributing the title in the language they prefer.

After completing the 12 frames that compose the protocol, the app asks to confirm that the test has been completed and then invites to save its content. Once saved, the app automatically returns to the home screen. The test is concluded.

In the upper-left corner there is an area called *private*, whose access is reserved to the examiner. By accessing the area, it is possible to display a summary screen with all the protocols completed within that tablet and saved. For each protocol is shown the gender and the date of birth of the person, the type of protocol (A or B) and the date on which the test was made. It is also possible to add an alphanumeric identification code to any completed protocol at saving time. By clicking on a single saved protocol, it is possible to visualize each of the frames that compose it and the scores automatically attributed by the system for each factor: at the moment the system is able to evaluate all the indices with the exception of flexibility (passage from one theme to another among the frames), that still needs a manual evaluation. It is also possible to insert/edit each score manually, even the automatically evaluated ones. Each saved protocol can be downloaded on the tablet into a spreadsheet

file. This file contains the title and scores of each frame, while drawings are downloaded in a Portable Network Graphics (png) format. One of the advantages of TCD-D is that it permits to store assessment results in a simple folder on the web. For this reason, it was decided to adopt a completely anonymous storage system, which keeps track of scores for all factors, including the ones that were not present in the paper version, for each frame completed by the user. The saving system works in offline mode, saving the tests locally in the device and then transferred manually in the online storage, or in online mode, using the Google Cloud suite to upload the data to protected and dedicated areas. In more detail, the automated assessment (Fig.4) made by the app takes into account the following factors:

- *Fluidity*: this is the amount of graphic production. The app, likewise the paper version, attributes one point to each frame in which even a single graphic sign has been drawn, zero points to frames without drawing.

- *Flexibility*: in the paper version, a point is given every time the subject changes category between one frame and another (e.g. living being frame 1, landscape frame 2). At the moment this is the only factor the app is totally unable to evaluate.

- *Originality*: it evaluates where the user draws. Each frame contains a closed part, created by the stimulus line or shape displayed. The tool assigns, according to the rules of the paper test, 1 point for drawings outside the closed shapes, 2 points for drawings inside the closed shapes and 3 points for drawings inside and outside the closed shapes.

- *Elaboration*: similar to the paper version, the symmetry of the drawing is evaluated. The tool assigns 0 points for symmetrical drawings inside and outside the closed shape, 1 point for asymmetrical drawings outside the closed shape, 2 points for asymmetrical drawings inside the closed shape, 3 points for asymmetrical drawings inside and outside the closed shape.

- *Title:* the title score depends on the length and complexity of the title, but is also influenced by the image recognition (i.e., the flexibility factor, which is not currently implemented). For this reason, currently the only possible scoring assignment is 0 points if the title is absent or 1 point if the user has attributed a title. The evaluator can then modify the score manually on the basis of the instructions provided in the paper version.

In addition to these parameters, already provided in the paper version of the test, we decided to implement some additional new parameters that enhance the assessment through a digital tool, taking into account the users of the test, that is, native digitals. In particular, the additional indicators are:

- *Reaction time*: it corresponds to the time it takes the user to make the first input from the moment the frame is proposed. Reaction times are commonly associated with intelligence because of the greater ability to process a large amount of information in less time, but the study by Kwiatkowski and colleagues [59] confirms that there is also a relationship between reaction times and creativity. The study of this relationship is still controversial, in fact, according to Glăveanu [60] reaction times are higher in more creative individuals, while according to the study by Dorfman and colleagues [61] reaction times depend on the type of task: lower reaction times for simple tasks that do not involve interference, higher reaction times for creative tasks that involve information interference (negative priming). Adding this index to the digital assessment of creativity will allow examiners to assess directionality of the relationship with divergent thinking factors in a drawing task.

- *Time to complete*: it corresponds to the time it takes the user to complete the drawing. It is tracked from the moment when the user starts drawing in the frame. The TCD manual [28] calls for completion of drawing protocols in 25-25 minutes, depending on the age group. However, often in group administrations, as is the case in classrooms, it is difficult to be able to maintain timelines and keep them in mind for individual case histories. This additional index makes it possible, not only to calculate the completion time of the entire protocol but also of individual figures for each student.

- *The number of erasures*: this is the number of times the student uses the eraser button.

- *The number of undo*: is the number of times the user uses the undo button.

The number of erasures is an index commonly used in graphic tests such as drawing human figures [62] and drawing clocks [63,64]. According to leading developmental psychology authors of the Human Figure Test [65, 66], the number of erasures is an index that can be interpreted as a lack of confidence and uncertainty in one's identity and, in a developmental context, can help distinguish between adolescents with high and low self-esteem. Today, several digital assessment instruments include the erasure index [e.g.67], but there are still no studies in the literature that examine the relationship between the number of erasures and creativity. These are some of the reasons for including these additional indexes to assess digital creativity considering the dual mode of erasure: erasure and undo.
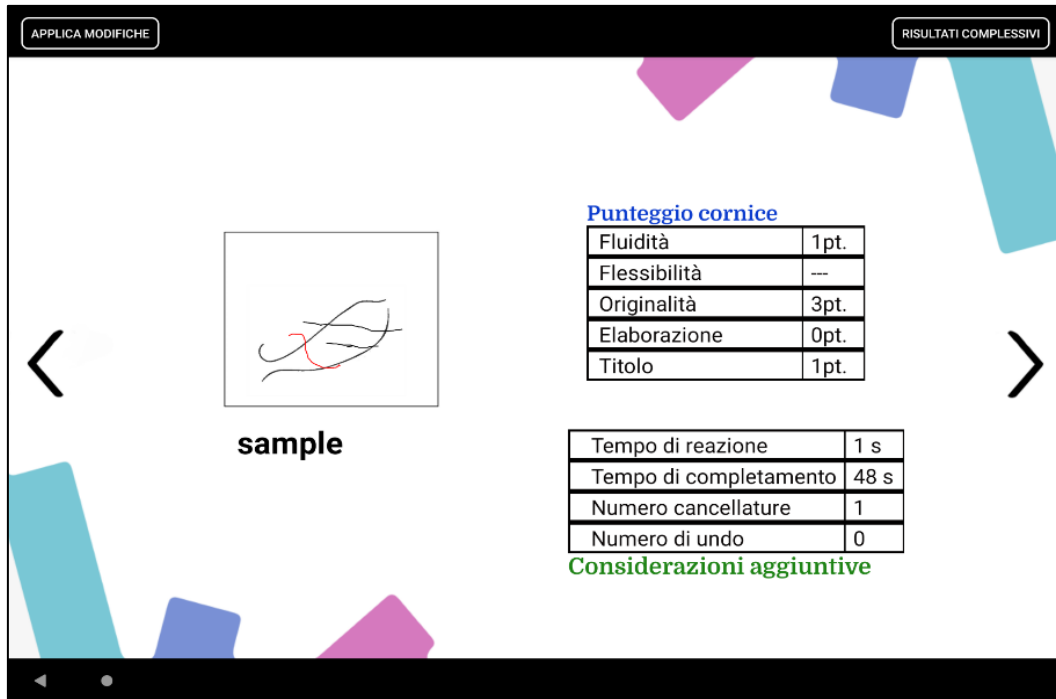
Fig.4 Screen with traditional Rating Indexes and additional ones

4.1 Participants

During this initial phase of app development, an exploratory study was conducted to assess reliability, construct validity, acceptability and sustainability of the app by a sample of university students. After our study was approved by the University Bioethics Committee (Prot. No. 157942), we distributed a questionnaire to students to consent to participate. Specifically, 34 students from the University of Turin in Italy participated in the study. Of the students who participated in this study, 32 were female and only 2 were male with an average age of 22.47 years (min=21 years; max=30 years).

4.2 Instrument

Students were presented with the Williams Test of Creativity and Divergent Thinking (TCD in Italy and CAP in other Countries) in both paper and digital formats in both protocols A and B (A paper + B digital or A digital + B paper). In the TCD (paper version) and in the TCD-D (digital version), there are five indices for assessing divergent thinking. Students were also asked to answer a short questionnaire that included open-ended questions and the System Usability Scale (SUS) [68]. The SUS was developed by Brooke in 1996 and contains ten simple questions about the usability of a system. The SUS is a useful tool for understanding the problems users have in using the system. It

is a ten-item Likert scale with five response options ranging from completely disagree (1) to completely agree (5). In addition to the socio demographic questions, participants were asked to indicate the frequency of use of PCs, smartphones, and tablets to better understand the use of new, traditional, and mobile technologies: the results are shown in Figure 5. The responses show that the tablet is the least used tool by the sample.
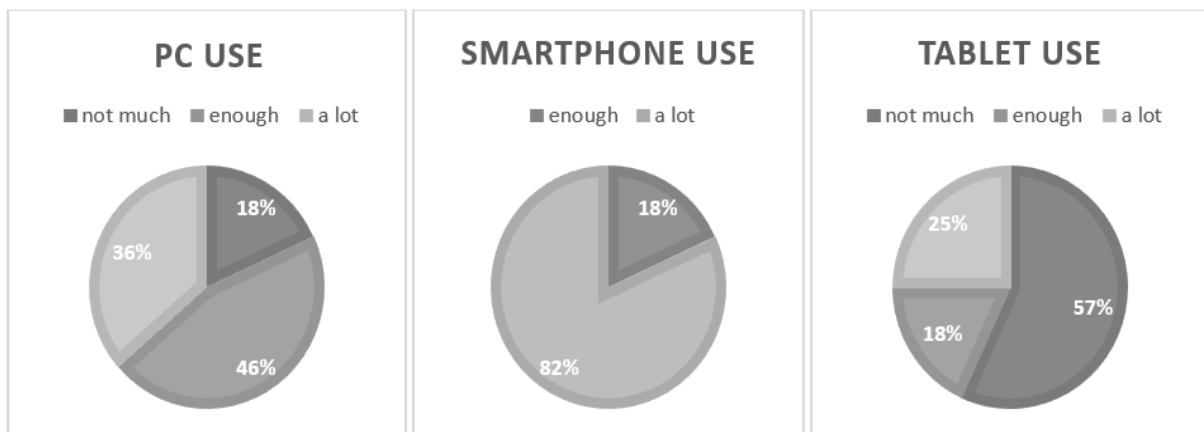

Fig.5 *Students' use of standard and mobile technologies*

5. Results

5.1. A significant challenge: the design of the Elaboration assessment

One of the key features of the Williams test [28] is the Elaboration, which gives a score based on the presence or absence of symmetries in the drawing. Symmetry can be mathematically defined as an orderly distribution of the parts of an object, such that geometric elements, be them a point or a line, can be identified so that each element of the object placed on one side of it corresponds, at equal distance, to a point on the other side. This process is a complex task because there are several variables to consider: the position of the lines, the consistency between the dimensions of the shapes that make up the symmetry, the rotation of the figure. Handmade drawings made by children will surely produce drawings that will not meet the mathematical definition of symmetry. Therefore, we researched for a suitable method. Our choice was implementing a method based on the Generalized orthogonal Procrustes analysis[11]. This method offers a certain degree of flexibility in considering two figures symmetrical or not, which is crucial given the target mentioned earlier. The key of the algorithm are the *landmarks*, which are elements defined as a finite set of points (independent of the number of

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[11] https://www.cse.sc.edu/~songwang/CourseProj/proj2004/ross/ross.pdf

actual points that compose the shape) that are placed on the figure and act as its "descriptors". These landmarks are essential for representing mathematical concepts closely related to symmetries, such as curvatures between two points. Once the algorithm has constructed a formal description of how the drawing is composed (by defining its landmarks), it is possible to compare the elements of the drawing among each other. Our implementation reduces the drawing area and divides it into four quadrants, then it compares them to each other and scores the matches found. With respect to the original implementation that involved a comparison based on individual small segments, this route was chosen because two elements, for example two eyes, can be drawn by hand differently and then vary greatly in the number of total coordinates, which would not make them comparable within the original implementation because they would result in an unmanageable increase of total landmarks.

In Figure 6 there is an example of a drawing on which to calculate the score about symmetries, based on the number of correspondences between the descriptors in each pair of the quadrants, with a certain chosen approximation (as described above). Our algorithm is meant to give good results on hand-drawing. For instance, it is possible to note in the drawing of Figure 6 that the right eye is not positioned as the exact opposite of the left eye and also the eyelashes differ in length. However, these differences are negligible for our algorithm (obviously if the position of the right eye was in the right upper corner, no symmetry would be detected). Another detail worth noting is the importance of the use of the above-mentioned landmarks: the irises would not be comparable without being considered as a landmark, *i.e.*, a descriptor independent from the actual number of its points, because the irises contain a large number of points each, making the element practically impossible to compare directly.
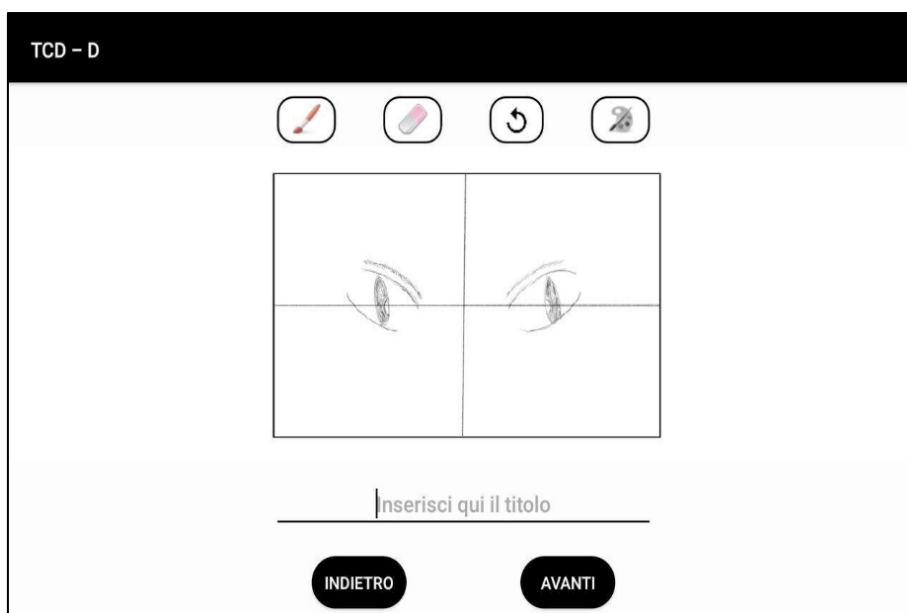
Fig.6 An example of symmetry.

5.2. Reliability and construct validity

The instrument's reliability and internal consistency were measured using the correlation coefficients of the main constructs. Of the three indices of divergent thinking assessed with the TCD-D app, fluency, originality and elaboration, Cronbach's alpha could only be calculated for two of them. The Fluency index is assessed by a dichotomous response (1, 0) based on the presence or absence of a design in each of the twelve frames. The low variability among the items, almost all of which are scored as 1 for the presence of drawings, makes it not possible to assess the alpha. For the other two indices, both positive and statistically significant in this study ($p < .001$), the Cronbach's alphas are .608 for originality and .665 for elaboration, respectively. This validity of the two indices is considered moderately acceptable (0.50-0.70) [69], especially considering the small number of subjects for which it was evaluated.

Pearson correlations were used to obtain an initial assessment of the construct validity of the indices measured with the TCD-D Mobile App [70]. Specifically, fluency, originality and elaboration measured with the TCD-D app and the paper version of the TCD test were shown to be correlated. As depicted in Table 1, each index measured with the TCD-D app correlated significantly with the corresponding index from the paper test. The remaining positive correlations between the indices (as in the case of fluency of the TCD-D with elaboration and originality of the paper TCD) are evidence that the three digital indices underlie the measurement of a single construct as in the paper version, namely divergent thinking.

Tab.1 Pearson's correlation coefficients

	Fluency TCD-D	Originality TCD-D	Elaboration TCD-D
Fluency TCD	.57**	.29	.10
Originality TCD	.48**	.63**	.23
Elaboration TCD	.46**	.61**	.40*
Note: **$p<.001$; *$p<.05$			

5.3. Study of acceptability and sustainability

A questionnaire consisting of open-ended questions and the SUS scale [68] was used to assess the acceptability and sustainability of the TCD-D mobile app. Of the 34 participants, 45% preferred

to take the Williams test digitally (TCD-D) and 56% of the sample felt that the digital test better expressed their creative potential. Despite the 55% who preferred the paper version of the test, participants' open-ended responses indicated that the TCD-D app is viewed as a faster tool that is less focused on perfectionism and errors. In addition, using the app is perceived as easy and intuitive, and more stimulating than the paper version because it offers more visual cues, more features, and a greater sense of freedom of expression. Additional data on the usability of the app came from the System Usability Scale. The SUS is a standardized questionnaire for assessing perceived ease of use [70, 71]. It is a quick and easy tool to obtain a valid measure of user-perceived usability and is one of the most reliable and widely used questionnaires recommended in the literature [e.g.72]. The standardized version of SUS consists of 10 items rated on a 5-point scale from "strongly disagree" to "strongly agree." Scoring is based on a rating scale developed by Sauro and Lewis [73] that divides scores into percentiles: The best score (A) ranges from 100 to 79, the acceptable score (B-C) ranges from 78 to 62, and the poor score (D-F) is below 62. Participants in the exploratory study rated the TCD-D with a score of 84.60, which corresponds to the A range or above the 96th percentile. The students' rating of the app's usability shows to be very high, although many of them are not very familiar with using tablets as a mobile tool.

6. Limitations

This study is not without its limitations: since it is the development of a prototype of a mobile app, it is only a preliminary study. The initial data collected in this study refer to a small sample that can by no means be considered representative of the sample used, i.e. the students of the University of Turin. Moreover, the not entirely satisfactory results of Cronbach's alpha and correlations are also related to the sample size. For these reasons, the present acceptability and sustainability results for the TCD-D app cannot be considered as a complete validation study. In addition, due to the constraints of the Covid 19 pandemic, it has not yet been possible to initiate a validation study with a larger school-age sample. However, data collection for a first validation of the application with university students is already underway and a second validation with a sample of Italian secondary school students is planned.

7. Conclusions

The TCD-D application, designed for use with mobile devices, specifically Android tablets, provides a digital resource for assessing creative potential and, in particular, divergent thinking in

educational settings. Unlike other attempts in the literature [such as 21], TCD-D was developed by a team of psychologists and computer scientists to simultaneously address relevant aspects of psychological assessment and app design.

The literature of recent decades supports the use of new technologies, particularly mobile technologies, to support assessment, monitoring, and creativity facilitation in educational settings [7;35,36]. Indeed, previously digitized measurement tools have several advantages over their paper-based counterparts: for example, to mention a few of them, new technologies allow for faster online test administration and automated scoring, which has reduced the time and cost of the assessment process [16;54]. Given these advantages, many creativity assessment instruments, such as the Torrance test [19], have been converted to digital versions [16;21]. The application of these new instruments in education shows that digital assessment not only enables large-scale assessment of creativity, but also provides teachers with an easy-to-use tool to monitor the development of students' divergent thinking by contributing to the development of creative potential [16]. However, to the best of our knowledge, there are currently no attempts to develop a digital (mobile-based) version of Williams' CAP [23], a widely used classroom divergent thinking assessment tool known as the Test of Creativity and Divergent Thinking [28] in China and Italy. For this reason, we developed the app TCD-D (Test of creativity and divergent thinking - digital form) for Android-based tablets. The app was developed as a faithful reproduction of the Williams instrument [28] and is capable of automatically coding three of the five creativity indices, Fluency, Originality, Elaboration. In addition to the standard indices found in the paper version of the test, the app provides the ability to monitor additional indices to better assess specific cognitive skills mentioned in the literature related to drawing tests and creativity: reaction time, time to completion of each graphic stimulus, and number of erasures/deletions per drawing.

The TCD-D mobile app achieved good Cronbach's alphas, albeit improvable due to the small number of the participants to the preliminary analysis. The correlations between the indices of the paper test and the mobile version are also interesting and encourage new studies in this area for further improvement. The TCD-D app was positively evaluated by university students who had the opportunity to test both the digital and paper versions. In particular, the ability to freely express one's creative potential without having to focus on artistic details, as is the case when drawing on paper, was appreciated. In addition, the app was positively evaluated in terms of usability, although this is a sample of students who do not use tablets as a tool on a daily basis.

Furthemore, there is room for improvement for the TCD-D app. For example, the app is currently only available in Italian, but it is important to note that the only verbal parts present concern the instructions for using the tool. For this reason, an implementation is already planned where the language can be switched, allowing individuals to choose the language they find most appropriate for receiving the test instructions and the indications on the drawing tools, thus overcoming the possible cross-cultural gap regarding the language. Another implementation concerns the flexibility factor, the only factor that currently cannot be automatically scored by the instrument and therefore requires manual coding input by the rater. In the future, and in accordance with these reflections, consideration could be given to incorporating an artificial intelligence-based image recognition algorithm into the app, so that a score can be assigned when moving from one figure category (e.g., object, animal, human, etc.) to another. To improve the scoring of the title, deep learning techniques can be used to measure the correspondence between a drawing and the title provided by the examinee, allowing for more accurate scoring.

The study has the merit of presenting the development of a user-friendly creativity assessment app that can be easily installed on Android devices, with the aim of promoting its dissemination in school and educational settings that often do not have particularly advanced technologies. In such contexts, however, the role of creativity and the ability to think outside the box is becoming increasingly important for the younger generation. Through the use of mobile technologies, it would then be possible to support the assessment of creativity and to monitor and promote the creative potential of students who are digital natives and connoisseurs of new technologies.

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Chapter 8. Conclusions and future perspectives

As we enter 2023, almost three years after the Covid-19 outbreak, we draw conclusions to understand what we have learned in terms of well-being and prevention (Alfano & Ercolano, 2020; Armocida et al., 2020; Beccia et al., 2022; Bourdin et al., 2022). The pandemic, like all major stressful and unforeseen events, delineated a before and an after. The scientific and technological breakthroughs of this time remind us that even in the darkest moments of history, good can come (Cohen & Cromwell, 2021; Heymann & Legido-Quigley, 2022). However, much can still be done.

Before the advent of Covid-19, the modern, fluid society we live in questioned the role of creativity in this rapid technological and generational evolution (Bauman, 2013; Henriksen et al., 2021). How can a transversal competence make a difference? How can one improve one's everyday creativity to better adapt to the context?

Several studies suggest that creativity plays a key role in development and lifelong learning (Anderson, 2020; Brosowsky et al., 2022). Throughout the life span, creative thinking, flexibility and creative adaptations support individuals as they study, work and navigate an increasingly complex society (Orkibi, 2021). Creativity is a transversal skill whose value is recognized, but which we find difficult to associate with well-being (Zhao et al., 2022). Studies confirm this: being creative helps people feel good (Metzl & Morrell, 2008; Humes, 2011; Orkibi et al., 2021; Karwowski et al., 2021). Creative thinking and behaviour helps in the production of adaptive responses, the expression of one's needs, relationships with others and the creation of valuable products, whether concrete or abstract (Karwowski et al., 2021). Everyday creativity guides adolescents and young adults in forming flexible identities that are ready to embrace the complexity of the world around them (Grigorenko, 2019). While systematizing such a dynamic construct still seems challenging, the pandemic has shown that it is indeed an implicit demand of communities in the face of new and stressful situations (Marciano, 2021). Creativity provides answers when the schemas one has are not sufficient to solve new problems (Patston et al., 2022). Creativity supported communities and individuals in all phases of the pandemic: the long lockdowns, the attempt to maintain routines, the need to continue educational and work activities (Palareti, 2020; Rabaglietti et al., 2021). Everything was possible thanks to creativity, also and above all to give meaning to an experience that deprived people of their normality (Kapoor & Kaufman, 2020). Thanks to new technologies, creativity took shape and was shared worldwide. The media and social networks have become the mirror of a society that does not stand still, reacts and moves forward (Mercier et al., 2021). For younger people in particular, creativity is an enormously powerful means of expression for their mental, physical and relational well-being (Ellis,

2022; Sica, 2022). Adolescents and young adults were the most vulnerable and particularly affected by the psychological consequences of the pandemic in terms of distress (De Oliveira Araújo et al., 2020; Binagwaho & Senga, 2021; Kauhanen et al., 2022). For them, the return to normality was even more affected by the gap between the pre-pandemic and post-pandemic periods. Only an arduous adjustment process and the redefinition of their identity and goals enabled them to recover a more functional dimension of everyday life. But not for everyone. Several studies show that more than two years after the start of the pandemic, young people in particular suffer the most severe consequences: depression, anxiety, sleep and eating disorders, drug use, self-harming behaviors and high suicide rates (Elmer et al., 2020; Benedetto et al., 2022; Landi et al., 2022).

In light of these considerations, this thesis focused on the role of creativity as a resource for young people. But how many studies have really analyzed the relationship between creativity and well-being in young people during the pandemic? How much has been said about the different ways creativity is used in everyday life in different European countries? And which assessment tools correspond to the technological revolution, research needs and preferences of the new generation of students?

These questions were attempted to be answered through three studies presented in the previous chapters (5, 6, 7), whose results and concluding reflections are presentend below.

8.1. Main results

8.1.1. Study 1

Regarding the specific objectives of the first study (section 1.3.1):

1 - Assess how many articles have covered the topic of creativity and resilience in relation to the post-pandemic situation.

2 - Identify the geographical origin (country) of the publications dealing with creativity and resilience.

3 - Assess how many articles measured creativity and resilience with a target group of adolescents or young adults.

4 - Describe how the constructs of creativity and resilience and any other related variables were operationalized and evaluated.

Study 1, shows that although the past two years have seen a focus in the media on well-being-related resources such as creativity and resilience (Giovannini et al., 2020; Kapoor & Kaufman,

2020), there is still little literature on this topic. In this mini-review, which examined more than 1,000 articles from 2020-2022, only 4 studies on creativity and resilience in relation to adolescent and young adult well-being were selected (Fan et al., 2021; Zeng et al., 2021; Li et al., 2022; Prasittichok et al., 2022).

In the early 2020s, social isolation, distance learning and smart working made it difficult to initiate new studies and associated data collection, except in an online format (Rashid & Yadav, 2020). This closure led to a drastic reduction in the number of publications and an increased focus on specific aspects of public health, such as the development of vaccines, drugs and therapies. Publication of social science studies did not return to pre-pandemic rates until the end of 2020: this may partly explain the low number of articles selected for review (Haleem et al., 2020).

All 4 articles in this review were published by Asian countries. This trend confirms what was already happening before the pandemic: Asian countries have been engaged in a campaign to promote creativity over the past decades, which has been consolidated through the support of scientific contributions (Chan & Yuen, 2014; Tan et al., 2022; Jyoti & Dev, 2015; Shin et al., 2012).

The sample of the selected articles consists of university students aged approximately 16-25 years, i.e. adolescents and young adults. University students represent a convenience sample for humanities studies, especially in the field of welfare and education. However, this is often an unrepresentative sample with wide variations in age and individual differences (Peterson & Merunka, 2014; Hanel & Vione, 2016). Many studies selected this population during the pandemic period (Hanel, 2020), as social isolation, disruption of educational activities and the impossibility of collecting data in the present made it difficult to initiate research with younger students.

Finally, the variety of models, instruments and theories considered for the studies in this review lead us to reflect on the true multidimensionality of creativity and the difficulty of providing a clear definition. Even today, the relationship between creativity and resilience is unclear and there are many variables related to creativity as a resource for young people.

8.1.2. Study 2

Regarding the specific objectives of the second study (section 1.3.2.):

1 - Are there differences in creativity factors, social support and resilience between university students in Italy and Spain?

2 - Is there a relationship between creativity factors, social support and resilience in the post-pandemic period in Italy and Spain?

3 - Do creativity factors (personality attributes, divergent thinking and problem solving) under the control of social support predict resilience differently between Italian and Spanish university students in the post-pandemic period?

Study 2 describes how the relationship between creativity, social support and resilience differs between Italian and Spanish university students in the post-pandemic period.

There are no differences between Italy and Spain in terms of resilience. This confirms that they are countries that have dealt with the pandemic in a similar way and at similar times: both are entering a phase of recovery and new adaptations (Faggioni et al., 2021; Núñez-Gil et al., 2021; Ruiz et la., 2021; Sandín et al., 2021). However, they differ on other resources: creativity is the most important resource for the Italian sample, while social support predominates in Spain. These differences confirm literature studies that creative personality attributes and social support are variables that are particularly correlated with culture of belonging (Luescher et al., 2019). Italy and Spain thus differ in the type of resources most perceived by students: more individual in Italy and more relational in Spain.

The results of the correlations between the variables show that the relationship between the creativity factors and relational aspects is stronger in the Spanish sample, while in Italy creativity remains a more individual resource. This different view of creativity in the two samples is confirmed by the literature. Indeed, creativity can be associated with relational aspects such as social support (Laguía et al., 2019; Tan et al., 2022), but at the same time it can also benefit from loneliness and poor social relationships (Karwowski et al., 2021; Mercier et al., 2021).

Finally, differences between the results of the regressions also emerge. Indeed, students in the two countries use resources differently to promote resilience. Although creativity together with social support significantly predicts resilience in both models, a more relational dimension of creativity prevails for the Spanish, while for the Italians creativity remains a more individual process. These differences in the creative dimension may be due to a number of factors, some of which are related to cultural background and others to students' age and social role. For example, most of the Italian students in this study are off- campus (Dal Bianco et al., 2010). This means that the social network of these students has changed recently. The distance from home, peer groups and family could help explain the lower perceived social support compared to Spanish fellow students and thus the search for more individual creative responses (Lau et al., 2013; Schudde, 2016).

8.1.3. Study 3

Regarding the specific objectives of the third study (section 1.3.3.):

- Developing a prototype mobile application that automates the assessment of three indices of divergent thinking: Fluency, Originality and Elaboration.

- Evaluate the reliability and reliability of the three measured indices of divergent thinking.

- Evaluate the sustainability of the TCD-D mobile application with a sample of university students.

Study 3 describes the development of the TCD-D app, an initial measurement of the validity and reliability of the tool and the results of the sustainability study. The app, developed by a team of psychologists and computer scientists, can currently automatically code three of the five factors of divergent thinking: fluency, originality, and elaboration. For the other indices, flexibility and title attribution, the app needs to be updated by implementing artificial intelligence, which is currently not available. In addition, the app is able to measure response time, completion time and number of erasures, additional indices added by the development team.

The initial validity and reliability results obtained by Cronbach's alpha for the three automatically measured indices are acceptable, especially given the small number of students who participated in the study (Bolarinwa, 2015). The correlations between the indices measured in the digital version (TCD-D) and the paper version (TCD) are also statistically significant.

Finally, the sustainability study shows that students do rate the usability of the app highly, even though some of them are not very familiar with using tablets as a mobile tool (Sauro & Lewis, 2016). Using the TCD-D app is perceived as easy and intuitive, and more stimulating than the paper version, as it offers more visual cues, more features and a greater sense of freedom of expression. These data show that the idea of large-scale creativity assessment through a digital tool is possible.

Thus, an important theme emerges from the students' open-ended responses: the digital version of the TCD tool not only has advantages in terms of economy and efficiency when it comes to assessing creativity on a large scale, but also implies a different approach to drawing as a form of expression of creativity. The digital represents a new space for creative process and production that is increasingly tangible and of value to new generations. The medium of paper, which has not lost its appeal, is joined by a new way of understanding creativity. While for decades creative genius was associated with great artists, including famous painters who made the canvas their personal virtual world, today creativity also finds its place on the touchscreen of every student's mobile device. The

infinite possibility to draw and erase without leaving a trace, to change and edit one's mind, but above all the reduced attention to the perfectionism of paper leaves space for imagination, originality and a new consciousness: the digital is a resource, also for creativity.

8.1.4. Overall results

In general, the results of this thesis work can be summarized as follows:

- Internationally, the promotion and implementation of creativity has been studied with great interest in the post-pandemic literature (Kapoor & Kaufman, 2020; Marciano, 2021; Karwowski et al., 2021; Grey & Morris, 2022). However, there are currently few studies that consider it as a resource for the well-being of those vulnerable to the effects of the pandemic: adolescents and emerging adults (Fan et al., 2021; Zeng et al., 2021; Li et al., 2022; Prasittichok et al., 2022). Indeed, there are few studies that have examined the relationship between creativity and resilient behaviours, such as adaptation and post-traumatic growth. Moreover, most of the studies that go in this direction are published by Asian countries that have been supporting the implementation of creativity with scientific literature for decades (Chan & Yuen, 2014; Tan et al., 2022; Jyoti & Dev, 2015; Shin et al., 2012). Currently, however, European research tends to focus on the socio-economic or technological aspects of creativity (Anser et al., 2020; Oparah et al., 2021; Sappa & Barabasch, 2020): Resources for well-being, especially of younger people, remain in the background.

    - European countries, particularly those in southern Europe, are characterized by a number of common features related to a shared historical cultural background: for example, attachment to the family and the importance of social relationships, but also the lack of adequate policies to support young people (Jurado-Guerrero & Naldini, 2018; Papadopoulos & Roumpakis, 2020; Martínez-Campillo & Fernández-Santos, 2020). In some of these countries, such as Italy and Spain, the pandemic had a significant impact on unwellness and psychological distress, especially among younger people (Varma et al., 2021; Samji et al., 2022; Ravens-Sieberer et al., 2022). Both countries have been working to promote creativity as a transversal skill for well-being and lifelong development before 2020. However, the results of Study 2 show that creativity, while a resource for all, could be used differently: for Italians, a more individual process that promotes well-being, and for Spanish, a more social dimension.

    - The pandemic has shown us how technological development, and mobile devices in particular, can support everyday life when used responsibly and correctly (Zaeske et al.,

2022). Moreover, the new generation of digital students, whom Prensky (2001) used to call digital natives, deal with new technologies differently: they master digital code, they have a multitasking learning mode based on search and exploration, they create and encode knowledge, and all of this has a major impact on the school experience (Smith et al., 2020). For decades, a growing number of studies have argued that technology can also be the answer to the dilemma of assessing creativity on a large scale, especially in educational settings (Barbot & Reiter-Palmon, 2019; Bolden et al., 2020). Tests, such as graphical tests measuring divergent thinking, can be administered on mobile devices with good usability. Paper-based instruments can be accompanied by updated and technological versions that are closer to new generations of digital students and more functional for data collection, even remotely (Chuang et al., 2015; Hoffmann et al., 2016; Guo et al., 2021). In addition, new technologies give us the opportunity to update and improve existing tools by speeding up assessment time, which can be automated, reducing human errors related to the subjectivity of assessment, and adding new indices for more detailed assessment of creativity.

8.2. Methodological limitations

The studies presented in this thesis work have some methodological limitations that need to be taken into account when interpreting the results and planning future studies on this topic.

First, the sample for each of the studies was not particularly large. In particular, the second study (Chapter 6) included only university students from two regions in northern Italy and Spain, while the third study (Chapter 7) included only a small group of students from the University of Turin. Moreover, all students were involved on a voluntary basis, so these are data describing the university population that would be most likely to talk about their wellbeing/illness after the pandemic. Future studies could include larger and more heterogeneous samples from different regions of Italy, Spain or other European countries for cross-national studies. The greater representativeness of the sample will allow the development of more appropriate models to describe the characteristics of creativity in Europe and validate the app at the national level.

Second, due to the cross-sectional design of the studies, it was not possible to assess the trend of creativity and its developmental trajectories over time during the pandemic. Future longitudinal studies can monitor the scientific literature on creativity as a resource for well-being, the emergence of additional resources among adolescents as a result of the pandemic, and the adoption of digital assessments for creativity. In this way, it will be possible to study the development of creativity in

the post-pandemic period and analyze its impact on well-being, economic, social and educational outcomes.

Finally, compared to other European countries, Italy does not have adequate validations of many of the most commonly used instruments internationally to measure creativity. Some of the instruments used in these studies are language adaptations. Cultural adaptation and validation of many scales and self-report questionnaires measuring creativity is one of the priorities that future studies can set in order to update national data and compare them internationally.

8.3. Applicative Implications

A number of key points emerge from the findings of this thesis that can provide food for thought and inspiration for the application of the findings.

-   The scientific literature supports the application of creativity.

To date, creativity has been applied in socio-economic and technological areas, but its application in terms of promoting psychophysical and relational well-being is still insufficient. For creativity to be truly interpreted as a resource, scientific studies need to support this view with evidence (De Oliveira Araújo et al., 2020; Di Fazio et al., 2022; Essadek et al., 2022). European policy is moving in a direction that promotes well-being, especially among younger generations who are less resilient and more vulnerable to the effects of the pandemic (Kauhanen et al., 2022; Regnoli et al., 2022). But the move to recognizing creativity as a fundamental skill for expressing one's needs and post-traumatic growth processes is still a long way off. Applying creativity to well-being also means exploring its relationships with other resources and the most effective interventions. Indeed, creativity has a positive impact on psychological as well as physical and relational well-being. Although work is already being done in educational settings on students' resources for well-being, much of the attention and interventions are focused on primary students. Much can still be done to encourage adolescents and young adults to believe in their own creative potential and learn how to use it, starting at school. Scientific research plays a key role in validating creativity and its value for individual and collective well-being.

-   International comparisons to improve knowledge of the multidimensionality of creativity.

Cross-national studies provide an important basis for comparison and discussion with other nations. By understanding what policies different countries have in place to promote creativity and what good practises can be shared, we can move in the direction advocated by UNICEF (2022), the European Council and Parliament (2009) and the Organization for Economic Cooperation and

Development (2019). Furthermore, it is important to examine how creativity finds its maximum expression to promote well-being based on the cultural-historical characteristics of a country (Cohen, 2012; Kim & Zabelina, 2015; Sawyer, 2017). In this way, it is possible to specifically implement programmes to promote creativity that are more functional and respect the characteristics of a group, community or nation.

- Introducing digital assessment of creativity in Italy.

Other countries in Europe and beyond are already using digital tools to assess creativity in business or education (Hoffmann et al., 2016; Smith et al., 2020; Rafner et al., 2022). Italy is particularly lagging behind here: it still relies on paper-based tools that were developed half a century ago for generations of young people and adults that are radically different today. Moreover, in many cases tools are used that have only been linguistically adapted and not really validated (Williams, 1994). The problem of measuring creativity still has major implications today, especially for fostering creative potential in educational settings (Grigorenko, 2019; Henriksen et al., 2021; Ellis, 2022). The lack of appropriate tools is one of the obstacles that do not allow the school system to adequately address creativity as a transversal skill. A mobile app that is easy to use, fun for students, and can be used to speed up and automate comprehensive assessments, including online, can be a first step towards monitoring creativity. Conversely, it can be complicated to promote a construct whose development is unknown.

8.4. Future Perspectives

The results of this thesis work and their application call for a number of future studies that will explore some unresolved issues.

First, future studies will be conducted with a more representative sample of the population in order to:

- describe the direction of interest in the literature regarding post-pandemic creativity. Therefore, populations of younger students and the relationship of creativity to other variables of well-being will be investigated. For example, variables related to physical, social-emotional and relational well-being will be considered.

- to describe which factors of creativity, individual or collective, process-related or person-related, are prevalent among students from Italy and other European countries in order to make comparisons in the post-pandemic period. Of particular importance is the representativeness of the

entire Italian territory, whose regions also differ considerably in terms of historical-cultural background as well as for socio-economic reasons.

- validation of the TCD-D app with a population of university students and lower grade students to check the reliability, usability and enjoyment of the tool among different generations of digital students.

The second objective is to design a longitudinal study to:

- track the developmental trend of creativity in the years after the age of Covid-19, taking into account different age groups and those most at risk, young and old.

- analyze creativity in the context of the school orientation process, taking into account the turning points in the transition from high school to university or job placement.

- using the TCD-D app, monitor standard indices of divergent thinking and complementary indices to accurately describe how creative potential is expressed in the educational context of future generations of digital students.

Finally, a joint study with researchers in computer science and complex systems will enable further development of the TCD-D app to include the use of neural networks and artificial intelligence. This type of implementation will enable large-scale national validation and dissemination of the tool. The database, which collects anonymous assessments of creativity, can be a valuable ally in monitoring the development of creative potential while encouraging it.

8.5. Conclusions

In conclusion, the pandemic has provided us a new perspective on the widespread need to promote creativity. The consequences of Covid-19 has brought into the spotlight the demand for help and support for vulnerable populations: wellbeing can no longer be postponed. Many countries have realized that creativity can be a key, a resource to invest in, starting with the development context par excellence: the education system. During the pandemic, it was discovered that new technologies can be valuable allies in everyday life, but the human component must also be considered. Imagination, problem solving, the ability to think outside the box and original thinking can make a real difference to individual and collective wellbeing. Creative potential is the answer, but the real question remains: are we ready to enhance it?

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Scientific Contributions

During these four years as a PhD student, I had the pleasure of becoming a member of the research group SE-CREA (Socio- Emotional learning and Creativity) of the Department of Psychology at the University of Turin. I also contributed to several scientific contributions, including papers and conference presentations (see below).

Journal Articles

Di Gesto, C., Incognito, O., Bartoli, M., **De Lorenzo, A.,** Porreca, A. Differenze di genere e predittori dei comportamenti sessuali a rischio: tratti di personalità, disregolazione emotiva e assertività sessuale. *I Quaderni della Fondazione dell'Ordine degli Psicologi della Toscana*. UNDER REVIEW

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Lattke, L. S., **De Lorenzo, A.**, & Rabaglietti, E. (2022). The relationship between students' Sense of Belonging, Grit and Anxiety during pandemic times. Revista Romaneasca pentru Educatie Multidimensionala, 14(4 sup 1), 488-499.

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Lattke, L., **De Lorenzo, A.,** Tesauri, B., & Rabaglietti, E. (2020). Dall'emergenza alla prevenzione: competenze socio-emotive e creative nella scuola di oggi. *Salute Umana, n°280, 2020*

Lattke, L. S., **De Lorenzo, A.,** Settanni, M., & Rabaglietti, E. (2019) Socio-relational well-being and dropout in vocational schools: a study on school engagement and satisfaction. *Well-being in Education Systems, 57.*

Rabaglietti, E., **De Lorenzo, A**., & Brustio, P. R. (2019). The role of working memory on dual-task cost during walking performance in childhood. *Frontiers in psychology, 10.*

Conference presentations

Psicologia e Complessità – 1°Convegno ORDINE PSICOLOGI TOSCANA - Firenze, 10/2022
Di Gesto, C., Incognito, O., Bartoli, M., **De Lorenzo, A.,** Porreca, A. (2022). Differenze di genere e predittori dei comportamenti sessuali a rischio: tratti di personalità, disregolazione emotiva e assertività sessuale.

XXX Congresso AIP- Padova, 09/2022
• **De Lorenzo A.,** Lattke L. S.,Rabaglietti E. (2022). Physical activity and Creativity to enhance well-being: a study among university employees in the post-pandemic period.
• Lattke L. S., **De Lorenzo A**., Rabaglietti E. (2022). Sense of belonging and Grit at school: their role role in reducing anxiety and self-harm amongst adolescents
• Bartoli, M., **De Lorenzo, A**., Di Gesto, C., Incognito, O., Porreca, A. (2022). And You, Sex(y) or Not? Gender Differences and Predictors of Risky Sexual Behavior: Personality Traits, Emotional Dysregulation and Sexual Assertiveness.

XXX Congresso Nazionale AIRIPA- Padova, 09/2022

De Lorenzo A., Lattke L.S., Tesauri, B., Rabaglietti E. (2022). La Creatività in classe: disegni e tematiche ricorrenti in studenti con sviluppo atipico.

XLVI Convegno Associazione Italiana di Epidemiologia- Padova, 07/2022
Sartini, Capra, Culasso, **De Lorenzo,** De Sario, Lattke, Minozzi, Paduano, Rabaglietti, Mitrova, Davoli, Bena, Marra, Saulle & Gdl AIE Scuola&Covid (2022). Impatto della chiusura della scuola per COVID-19 sul benessere psicologico dei giovani: una revisione sistematica della letteratura.

8th Ensec-Social Emotional Learning And Positive Development- Suacea, 07/2022
Lattke, L.S., **De Lorenzo, A**., & Rabaglietti, E. (2022).The Relationship Between Students' Sense Of Belonging, Grit And Anxiety During Pandemic Times

XV CONVEGNO NAZIONALE DI PSICOLOGIA DELL'INVECCHIAMENTO- Padova, 26/05/2022
Rabaglietti E., Mulasso A., Bertaggia L., **De Lorenzo A**. (2022). "Benessere fisico e psicologico nel post pandemia Covid-19: uno studio su dipendenti adulti della comunità UNITO"

The Development of Prosocial and Aggressive Conducts: Understanding and Interventions- Firenze, 05/05/2022
De Lorenzo A., Lattke L.S., Rabaglietti E. (2022). "Creativity and emotions in primary school: a pilot study with Z-Lab's laboratories"

ATEE Spring Conference 2020/2021-Social justice, media and technology in teacher education- Firenze, 28/10/2021
Bioglio L., Capecchi S., **De Lorenzo A**., Di Noi V., Marino G., Pensa R., Settanni M., Tirocchi S., Venturini G. (2021). "Social4school: educating on awareness in online social networks"

XXXIII Congresso Nazionale AIP sezione Psicologia dello Sviluppo e dell'Educazione- Bari, 09/2021
De Lorenzo, A. Chair del Simposio: "Adolescenti e giovani adulti: nuove sfide per il benessere psicologico e sociale tra rischio e risorse".
• **De Lorenzo, A.,** Lattke, L.S., & Rabaglietti, E. (2021). "Le risorse degli adolescenti in periodo pandemico: il ruolo dell'autoefficacia e della creatività".
• Lattke, L.S., **De Lorenzo, A.,** & Rabaglietti, E. (2021). "Nuove sfumature relazionali, verticali e orizzontali, durante la pandemia: la prospettiva degli studenti".

EADP Summer Tour 2021 DEVELOPMENTAL TRENDS: CONCERNS AND OPPORTUNITIES- Polonia, 08/2021
De Lorenzo A., Lattke L. S., Tesauri B., Rabaglietti E. (2021) "How did body image affect self-efficacy during the pandemic period? A mediation study on Italian adolescents"

Giornate di Studio AIP "Emergenza COVID-19. Ricadute evolutive ed educative" Sezione di Psicologia dello Sviluppo e dell'Educazione- Bari- Online, 14/09/2020
De Lorenzo A., Lattke L. S., Tesauri B., Rabaglietti E. (2020). "Lo stress percepito degli insegnanti nell'organizzazione della didattica a distanza (dad) attraverso la mediazione dell'autoefficacia: uno studio cross-national"

Salone dell'Orientamento – COSP- Torino, 20/11/2019
Rabaglietti E., **De Lorenzo A.,** Lattke S. L. (2019). "Come motivare allo studio? Confronto su risorse e strategie"

2• Convegno internazionale sul benessere nei sistemi educativi- Locarno, 11/11/2019
Lattke L. S., **De Lorenzo A.,** Settanni M., Rabaglietti E. (2019). "Socio-relational well-being and dropout in vocational schools: a study on school engagement and satisfaction"

XXXII Congresso Nazionale AIP sezione Psicologia dello Sviluppo e dell'Educazione- Napoli, 22/09/2019
• **De Lorenzo A**., Settanni M., Marengo D., Capecchi S., Pensa R.G., Rabaglietti E. (2019)." Certo che sono connesso!!": nativi digitali e comportamenti a rischio nell'uso dei social media.
• Rabaglietti E., Lattke S.L., **De Lorenzo A**., Settanni M. (2019) A scuola, io insieme con... adolescenti tra competenze socio-relazionali e rischio di dispersione scolastica.

5th Italian Conference on ICT for Smart Cities And Communities- Pisa, 17/09/2019
Bioglio L., Capecchi S., **De Lorenzo A**., Di Noi V., Marino G. M., Pensa R.G., Settanni M., Tirocchi S., Venturini G. (2019) Let's play the social network game: a gamification approach for digital citizenship.

XXXI Congresso Nazionale AIP sezione Psicologia dello Sviluppo e dell'Educazione- Torino, 16/09/2018
• Rabaglietti E., Casella B.,Ortega E.,Calgan B., **De Lorenzo A**. (2018) Giovani e social network: uno studio cross-nazionale su relazioni face-to-face e virtuali e aspetti del sé.
• **De Lorenzo, A.,** Mauri, A. & Rabaglietti, E. La Creatività nelle classi multiculturali: uno studio nella scuola primaria.

Appendix

Fig.1 The article screening process Flow Diagram according to the PRISMA 2020 Statement guidelines

Tab1. Characteristics of the final four articles included in the review

Authors	Titles	Years	Covid Publication	Geaographical area	Target sample	Models, Instruments and other variables
Fan, Cai & Jiang	Can team resilience boost team creativity among undergraduate students? A sequential mediation model of team creative efficacy and team trust.	2021	No	Mainland China	University students (no age)	Sequential mediation model; (IV)Resilience: Team Resilience Scale (Mallak,1998) (DV) Creativity: Team Creativity Scale (Rego et al., 2007) Other variables: (Me) team creative self-efficacy; team trust
Li, Liu, Yang, Du, Xie, Xiang, Duan & Hu	The influence of resilience on social creativity: Chain mediation effects of sense of humor and positive mood	2022	No	Northwest China	University students (16-21 y)	Sequential mediation model; (IV)Resilience: Resilience Scale for Chinese Adolescents (Hu & Gan, 2008) (DV) Creativity: Social Creative Questionnaire for University Students (SCQ; Hu & Yang, 2010). Other variables: (Me) sense of humor and positive mood
Prasittichok & Klaykaew	Meta-skills development needs assessment among undergraduate students.	2022	No	Bangkok	University students (18-25 y)	Description of desire and current states of meta skills; Resilience and Creativity: needs assessment Meta-skills scale (Kaufman, Rojas & Mayer,1993; Razzetti, 2018) Other variables: Self-Awareness
Zeng, Zeng, Xu, Huang, Shao, Wu, & Wu	The influence of post-traumatic growth on college students' creativity during the COVID-19 pandemic: the mediating role of general self-efficacy and the moderating role of deliberate rumination	2021	Yes	Guangdong Province, China	University students (no age)	Moderate mediation model; (IV) Resilience: Posttraumatic Growth Scale (Geng et al., 2011), (DV) Creativity: Runco Ideational Behaviour Scale (Runco et al., 2000) Other variables: (Me) self-efficacy (Mo) rumination

Note: IV= independent variable; DV= dependent variable; Me=mediator variable; Mo=moderator variable

Table1: descriptive statistics, for the total sample (n = 314), Italian (n =166) and Spanish (n = 148) samples

	Sample	Min	Max	Mean	SD	Skewness	Kurtosis	*t*-score
Creative Personality Attribute	**Total**	-6	13	2.62	3.26	.45	.42	
	IT	-3	13	3.60	2.98	.65	1.00	5.96**
	ES	-6	11	1.51	3.21	.58	.25	
Divergent Thinking	**Total**	54	105	79.45	9.37	-.07	.07	
	IT	54	105	83.19	8.53	-.20	.49	8.25**
	ES	55	101	75.25	8.47	.02	.37	
Problem Solving -Positive	**Total**	1	20	10.80	3.62	.16	-.28	
	IT	2	20	10.83	3.58	.12	-.18	.11
	ES	1	20	10.78	3.66	.21	-.36	
Problem Solving -Negative	**Total**	0	20	9.37	4.47	.25	-.67	
	IT	0	20	9.31	4.37	.26	-.47	-.22
	ES	1	20	9.43	4.60	.23	-.86	
Problem Solving -Rational	**Total**	1	19	11.16	3.69	-.07	-.24	
	IT	2	19	11.15	3.60	-.11	-.27	-.06
	ES	1	19	11.17	3.79	-.03	-.20	
Problem Solving -Impulsive	**Total**	0	17	4.04	3.46	1.18	1.44	
	IT	0	17	3.63	3.69	1.48	2.21	-2.21*
	ES	0	15	4.50	3.14	.85	.63	
Problem Solving -Avoidant	**Total**	0	18	4.17	3.94	.94	.32	
	IT	0	15	3.31	3.44	1.14	.67	-4.17**
	ES	0	18	5.13	4.25	.69	-.05	
Social Support	**Total**	12	84	66.49	13.06	-.97	1.39	
	IT	23	84	64.27	12.25	-.49	.01	-3.24**
	ES	12	84	68.99	13.52	-1.56	3.50	
Resilience	**Total**	1	30	15.40	5.90	-.44	.33	
	IT	1	30	14.93	5.54	-.48	.60	-.89
	ES	2	30	15.93	6.93	-.44	.13	

*p<0,05; **p<0,001
Note: Total=Total sample (n=); IT =Italian Sample (n=); ES = Spanish Sample (n=);
All skewness smaller than 2 and all kurtosis smaller than 7 indicate a normal distribution, denoted by Kline (2013).

Table2: creative personality, divergent thinking and problem-solving types

Variables	Sample	1.	2.	3.	4.	5.	6.	7.	8.
1.Creative Personality Attributes	IT								
	ES								
2.Divergent Thinking	IT	-.021							
	ES	.36**							
3.Problem Solving-Positive	IT	.00	.30**						
	ES	.28**	.52**						
4.Problem Solving-Negative	IT	.02	-.17*	-.46**					
	ES	-.24**	-.31**	-.32**					
5.Problem Solving-Rational	IT	.08	.36**	.46**	-.14				
	ES	.13	.41**	.58**	-.15				
6.Problem Solving-Impulsive	IT	.16*	-.05	.09	.23**	-.25**			
	ES	.11	-.04	.00	.28**	-.29**			
7.Problem Solving-Avoidant	IT	.06	-.09	-.33**	.46**	-.22**	.41**		
	ES	-.06	-.22**	-.48**	.44**	-.23**	.19*		
8.Social Support	IT	.06	.04	.29**	-.16*	.29**	-.18*	-.37**	
	ES	.21*	.21**	.24**	-.10	.07	.00	-.25**	
9.Resilience	IT	-.05	.32**	.64**	-.64**	.30**	-.04	-.36**	.30**
	ES	38**	.50**	.57**	-.61**	.37**	-.13	-.41**	.32**

Note: *p<0.05; **p<0.001

IT =Italian sample; ES = Spanish Sample

Table 3: Summary of Hierarchical Regression Analysis for Variables predicting Resilience for Italian and Spanish sample

Independent Variables	Italian Sample					Spanish Sample				
	β	T	R^2_{adj}	ΔR^2	$F_{(gdl)}$	β	t	R^2_{adj}	ΔR^2	$F_{(gdl)}$
Step1										
Social Support	.30**	4.05	.08	.09	16.41** (1,164)	.32**	4.15	0.10	0.10	17.27** (1,146)
Step2										
Social Support	.30**	4.10	.08	.00	8.68**	.25**	3.39	0.19	0.10	19.02**
Creative Personality Attributes	-.07	-.98			(2,163)	.32**	4.32			(2,145)
Step3										
Social Support	.12*	2.22	.57	.50	33.38**	.16*	2.79	.58	.39	30.40**
Creative Personality Attributes	-.05	-.99			(7,158)	.11	1.89			(7,140)
Divergent Thinking	.12*	2.22				.12	1.85			
Problem Solving- Positive	.37**	5.64				.25*	3.15			
Problem Solving- Negative	-.44**	-7.08				-.43**	-6.96			
Problem Solving- Rational	.00	.04				.08	1.23			
Problem Solving- Avoidant	.02	.42				-.00	-.03			

*p<.05; **p<.001