CREATIVE LITTLE SCIENTISTS: Enabling Creativity through Science and Mathematics in Preschool and First Years of Primary Education

D2.2 Conceptual Framework
ADDENDUM 2 of 4:
Literature Review of Creativity in Education

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Task 2.3: Literature Review of Creativity in Education

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Introduction
This thematic review addresses conceptions of creativity in education with particular reference to the early years with regard to both research and policy. It commences by considering the theoretical literature on the nature of creativity and innovation in education, then in the second subsection the focus shifts to early childhood education and we consider such issues as pedagogy, curriculum and learning. Thirdly, we review the ways in which creativity has been documented and evaluated in the early years and fourthly the review addresses methodological issues emerging from consideration of the research approaches used at this age phase to investigate creativity. Lastly, the review examines the policies for creativity across Europe, with particular reference to the nine countries involved in the study and highlights commonalities and differences in the way in which creativity is conceptualized by governments. The review closes by considering emerging tensions and dilemmas, as well as the opportunities offered by the Creative Little Scientists research project in contributing to knowledge and understanding in this area.

Process of the review
In this thematic review, no particular theoretical perspective was adopted; rather the authors sought to map the field as comprehensively as possible within the limitations of time and considered studies from a range of perspectives including psychology, sociology, philosophy and education. The main aim of the review was to explore what is known about creativity in the early years spanning pre-school and the early years of primary education. It synthesises and reflects on relevant research and draws out issues and themes for consideration by the study Creative Little Scientists. In common with the other three Literature Reviews being undertaken alongside it, the team did not confine themselves to scholarly work related to the age phase 3-8 years (the focus for Creative Little Scientists), but also reviewed relevant and significant work in the field beyond this, broadly from the years 1990-2011 in relation to research studies and from 2000 in relation to the policy documents. However it was agreed exceptions would be made for ‘landmark’ studies and for the work of significant theorists. Several existing literature reviews (Craft, 2001; Craft, 2010; Davies et al., 2011; Kahl et al., 2009) were also consulted. Methodologically, the studies ranged across the interpretivist / positivist paradigm spectrum, both in terms of conceptual and empirical pieces although included very few studies in the critical paradigm. This reflects the current state of play in the English-speaking research field, with many empirical studies from the USA and far East adopting quantitative or mixed methods, and a tendency for European studies to be more focused on qualitative approaches in the interpretive paradigm.

A thematic narrative review was chosen on account of its flexibility and initially areas to be examined were identified by the team as a whole, led by the OU and based on extensive experience in the field of creativity.
research. These were considered to be the key research issues that needed to be trawled so as to situate creativity in early years education, conceptually and historically and in order to encompass the current and recent policy context within Europe and the nine participating partner countries in Creative Little Scientists.

Core members of the review team for Work Package 2.3 worked to select appropriate materials from the agreed period and produced rubrics developed to a common format across the Work Package which summarised the research questions, methodological approaches, research design and sampling procedures and the key findings of each selected piece of research. For policy, the period in which the policy applied (emergent/current/past) was recorded together with status (guidance or mandatory), the age group to which it applied, and the key messages conveyed by the document. Selection was grounded here for research in the partners’ experience and expertise in the area under investigation and with reference to policy, in relation to their knowledge of the recent national policy documents in their own countries. Completion of a rubric did not however ensure the paper was included in the review, since the core team undertook an additional selection process to ensure suitability of the material to the foci of the work.

During the review process, the core team met regularly using Skype or face to face to discuss the emerging themes and topics in the areas of creativity in the early years and to discuss the rubrics and particular papers with reference to selection and inclusion. At each meeting issues of potential bias were considered and addressed. One limitation which needs to be acknowledged is that the cited literature does not explicitly cover all the literature concerning creativity and early years, though concomitantly a real strength of the review is that the breadth which is encompassed, allows for over-arching conceptual frameworks to be outlined and more detailed analyses of particular studies to be examined. Additionally, the review is able to draw on a number of valuable studies which have not been published in English, but which partners were able to review and for which they were able to complete rubrics.
A. Nature of creativity and innovation in the early years

The study of creativity and innovation in the early years draws on a range of influences from psychology and philosophy of childhood/child development. Spanning the nature of creativity (in particular, as opposed to innovation) and of learning or development in childhood, research psychologists, therapists, educators and carers concerned with young children all contribute with sometimes overlapping perspectives. This section of the literature review considers the nature of creativity and innovation, then turns to creativity in education with particular reference to the early years.

A1. Creative processes/models of creativity and innovation

Creativity is defined with various degrees of difference by researchers, however within the discipline of psychology (where most of the recent research on creativity has been undertaken in relation to education) it is defined as "the ability to produce work that is both novel (i.e., original, unexpected) and appropriate (i.e., useful, adaptive concerning task constraints)" (Sternberg and Lubart, 1999: 3).

The notion of creativity as generating original and appropriate outcomes compresses the four P’s of Person, Process, Product, Press which Rhodes (1961) originally identified, combining the production of original and valuable outcomes with the impact of these on others.

Within psychology many paradigms co-exist for understanding creativity and over time there has been a transition from more linear approaches toward more integrative approaches (where several elements are taken into account simultaneously). Sternberg (2003) outlines this journey through eight paradigms (mystical, psychodynamic, cognitive, psychometric, pragmatic, social-personality, evolutionary and confluence) drawing on his earlier work with Lubart (1999) in which seven paradigms are identified, as a result of trawling references to creativity in psychological journals in the last quarter of the 20th century. Sternberg’s (2003) group of eight can be organised and extended with the addition of humanistic approaches to make nine distinct but overlapping approaches as follows:

A1.1 Ancient approaches to creativity

A1.1.1 Mystical

Stemming from Plato’s account of creativity and also reported in many studies where creators sense inspiration coming ‘through’ rather than ‘from’ them, which was then challenged by the Romantic Era in Europe in which human creativity was recognised as not purely ‘divinely inspired’.
A1.2 Early/mid-20th century: Deductive, philosophical tradition

A1.2.1 Psychodynamic
Creativity understood as arising through ‘tension between conscious reality and unconscious drives’ (Sternberg, 2003: 92) as developed by Freud (1908/1959, 1910/1964) leading to elaborated theories of adaptive regression and elaboration (Kris, 1952) and other theories emphasising aspects of the unconscious and preconscious. Psychodynamic approaches to creativity informed the work of Winnicott (1971) and others investigating play and creativity in young children, and has been influential in this regard although in general psychodynamic approaches have been marginalised in psychology in the late 20th and early 21st century.

A1.2.2 Cognitive
The search for models that explain the mental processes and representations underpinning creative thought, the cognitive approach in psychology has investigated relationships between creativity and intelligence in which some of the recent research (e.g. Weisberg, 1993, 1999) has suggested that creativity harnesses ‘ordinary cognitive processes yielding extraordinary products’ (Sternberg, 2003: 98). Among the first models of the creative process, Wallas (1926) divided the creative process into four main stages (preparation, incubation, illumination and verification). The preparation phase is the gathering of internal information proper to each individual, and the external one coming from the environment. The incubation step is defined as the implementation of unconscious associations. During the illumination, the ideas appear to consciousness. The last stage of verification compares the ideas to reality and makes selections. Similarly, Guilford (1950), proposed a four-stage model which involved the same steps than Wallas, yet other more recent approaches, for example Cropley and Cropley (2008), have recognized the importance of communicating creative ideas successfully and so offer an extended model involving seven parts (preparation, activation, cogitation, illumination, verification, communication and validation). Cognitive approaches also include Mednick’s (1962) associative process, and Hudson’s (1968) recognition that creativity involves both divergent and convergent thought. From these early models emerged recognition of certain abilities and cognitive processes involved in creativity, as, “a capacity to produce many ideas (fluency), an ability to change one’s mental set (flexibility), an ability to reorganize, an ability to deal with complexity, and an ability to evaluate” (summarised in Lubart, 2000-2001: 295, drawing on work by Guilford and also Torrance). More recent cognitive approaches also include studies which seek to understand computer simulations of creative thought (for

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There are some potential parallels between these stage-models of creativity and its communication, and Bybee’s ‘5E’ model (discussed in Bybee et al., 2006) which has influenced science education internationally: this too consists of stages comprising Engagement, Exploration, Explanation, Elaboration and Evaluation. However it could be argued the 5E model is more focused on scientific exploration than on creativity.
example Boden, 1999, 2004) as well as the relationship between generative and exploratory phases in creativity such as the Geneplore model (Finke et al., 1992 and Ward et al., 1999).

A1.2.3 Humanistic
Emerging from a therapeutic tradition, the humanistic approach essentially sees creativity as making something of one’s life, or as self-realisation. Two theorists in particular were highly influential in exploring the nature of ‘self-actualization’ Maslow (1971, 1987), and Rogers (1954, 1970). Both drew on psychodynamic theories to develop ways of understanding human capacity to make creative change. Maslow developing a ‘hierarchy of need’ and Rogers developed the concept of ‘unconditional self-regard’ or recognition of worth, as a way of enabling the emergence of the natural creative impulse in all with consequent implications for pedagogy.

A1.3 Mid to late 20th century: inductive, empirical tradition
A1.3.1 Psychometric
A measurement-focused approach to creativity as divergent thinking, scored via context-free tests similar to IQ tests; the most influential of which are the Torrance Tests of Creative Thinking (1966, 1974, 2008) which build on Guilford’s earlier work and Mooney’s (1963) four elements of place, product, process and person by evaluating in its most recent version, using five subscales for fluency, originality, elaboration, abstractness of title and resistance to premature closure, and can be seen as building out of the cognitive tradition. Other tests include the Wallach-Kogan tests (1965) used extensively in Hong Kong, which focus on fluency, flexibility, uniqueness and unusualness. This measurement approach led to a shared conception among psychometric researchers that creative people tend to have higher IQs (above 120; Renzulli, 1986), yet al.though extremely creative people often have high IQs, not all people who have high IQs are extremely creative, and final that creativity and IQ matter differently depending on the domain of activity the creativity is manifest in- the role of intelligence being higher in mathematics and science than in art and music for example (McNemar, 1964). Although the critique of the psychometric approach is that it is disembedded from authentic situations, and thus lacks validity, it is nevertheless used widely through the Torrance and other tests of creative thinking within USA, Middle and Far Eastern contexts though is shunned in many European ones which tend toward a context-focused approach to understanding creativity.

A1.3.2 Pragmatic
Practical approaches such as those developed by Edward de Bono (e.g. 1985) in developing ways of nurturing ‘lateral thinking’, also Gordon’s (1961) analogy-based creative thinking and many others. Other approaches include mind mapping (Buzan, 1985) brainstorming approaches as summarised by Isaksen (1998), and the Inventive
Problem-Solving Technique (TRIZ) initiated in the 1940s in Russia and used mainly in business environments worldwide (Akay et al., 2008; Hua et al., 2006). Synectics is a further approach used in business but also applied in schools and there is some evidence from the early years that this approach can increase young children’s creativity (Meador, 1995).

A1.3.3 Social-personality
Developed in parallel with cognitive work on creativity, researchers within this tradition have focused on personality, motivation and socio-cultural context to creativity. A range of researchers (e.g. Amabile, 1983; Bruner, 1986; Gardner, 1993; Hennessy, 2003; Policastro and Gardner, 1999) have studied creativity in both ‘little c’ or everyday and ‘high c’ or paradigm-shifting contexts (each of these terms is further explored in section B1 of this review) and have concluded (summarised by Brolin, 1992) that the creative personality exhibits: strong motivation, endurance, intellectual curiosity, deep commitment, independence in thought and action, strong desire for self-realization, strong sense of self, strong self-confidence, openness to impressions from within and beyond self, high sensitivity, high capacity for emotional involvement in their work, willingness to take risks. Critiques of personality studies suggest they are overly focused on the unique person and so it is difficult to make comparisons and yet there is surprising agreement between studies.

A1.4 21st century approaches: inductive and deductive traditions
A1.4.1 Evolutionary approaches
Exploring the evolution of ideas, key proponents include Perkins (1995), Simonton (1995, 1998, 1999) and Sternberg (2000), and recent work has also been developed by Sweller (2009). This theoretical approach suggests there are two steps involved in creativity: blind variation (the generating of ideas without regard to their potential for success in the applied world – this is the generativity phase) and selective retention (choosing what to take forward – this phase focuses on novelty and value). The two steps together lead to the survival of the most creative possibilities. The approach assumes that creators generate many ideas since only a few will be selected. Critics however who include Perkins (1998) himself argue that framing creativity solely using this paradigm may be inadequate used alone; since the emphasis on ‘blind variation’ may diminish the role of knowledge, expertise, and sensitivity to what is appropriate all of which are likely to come into play in generating ideas in the first place. Although Simonton (2011) argues whilst knowledge does play a role it seems likely that blind variation is indeed at play. Gabora (2005) argues that creativity evolves, but through a process of context-driven actualization of potential and not via a Darwinian natural selection. Sternberg meanwhile suggests that the evolution of ideas is inherently creative in that mutations of ideas challenge convention, and can transform existing ways of thinking and doing, he explores the dialectic
tension between old (intelligence or conventional thesis) and new (creativity as antithesis) with wisdom enabling synthesis of the two.

**A1.4.2 Confluence approaches**

Essentially recognising multiple components converge in enabling creativity, confluence theorists include Amabile (e.g. 1983, 1997) who theorises the relationships between intrinsic motivation, domain knowledge and creativity skills, Csikszentmihalyi (1988, 1996) who proposed the ‘systems approach’ combining individual, domain and field, Gardner (1983) who suggested from his studies of high creators that anomalies in systems seem to generate creativity, Gruber (1981, 1989) who developed an ‘evolving systems model’ which integrated knowledge, purpose and affect, and explored the importance of ‘networks of enterprise’ that support highly creative people, and Sternberg and Lubart (1991, 1995) who propose an ‘investment theory’ of creativity, in ‘buying low and selling high’. Confluence theories appear to explain paradigm-shifting or big c creativity where multiple components need to co-occur. Calwelti, Rappaport, and Wood (1992) suggest the simultaneity of processes such as centring on a topic, working on new ideas, expanding ideas, evaluating, and taking distance from one’s work. Other authors propose a systematic approach to creativity (Csikszentmihalyi, 1996) where the individual interacts with a domain of knowledge and a field (persons who value). Sternberg and Lubart (1993), in their model, have identified six different resources that may play a role in a creative production, namely, aspects of intelligence, knowledge, cognitive styles, personality, motivation and environment. More recently Lubart et al. (2003) refined this model by including emotional factors. The confluence approaches recognise that cognitive, conative and environmental factors contribute to the establishment and development of creativity. According to this point of view, Mumford et al. (1994) argued that creative problem solutions require expertise, adaptability, motivational and dispositional characteristics. Moreover as Lubart (2000-2001) noted, the difference between creative and non-creative processes focuses on a continuum rather than a dichotomy. In fact what is important for creative work is knowledge, motivation and the nature of the problem-solving task. Yet, Cropley and Cropley (2008), drawing on (Cropley 1997) who reviewed many other studies highlight a range of paradoxes within the study of creativity as shown in Table 1 (ibid :357).
Table 1: A range of paradoxes within the study of creativity

Among other tensions, the social paradoxes highlight the potential for anti-social or oppositional social relations, which in turn helps to illuminate why creativity can be both welcomed in the classroom and also perceived as a challenge.

A1.5 The shift toward understanding creativity as a social phenomenon

As well as a shift toward approaches that recognise the complexity of creativity, research over the course of the late 20th century has increasingly focused on the role of dialogue and collaboration in creativity. The field was influenced by Gruber’s (1985) work on networks of enterprise that support and enable scientific creativity inspired by his work on Darwin. It has also been given direction by the seminal research of John-Steiner (2000) who explored the creative work of paradigm-shifting individuals in a variety of contexts from the arts to the sciences, and revealed the extent to which artistic and scientific forms are shaped creatively through shared intellectual, emotional and passionate connection in the meaningful relationships between people. She revealed the shared struggles involved in creative generativity. Her work has been developed by many in education but particularly by Chappell (2008) who...
highlights the interplay between individual, collaborative and communal creativity and the distinction between collaborative (which is focused on generating outcomes with other/s), and communal creativity (where those involved have an equal and shared stake in what is being done).

With the increasing recognition of creativity as a social phenomenon has also developed a focus on the ethics of creativity in relation to its ends. Sternberg (1985, 2002, 2003) introduced the exploration of creativity and wisdom, a challenge taken up by Claxton et al., (2008), who argue for the need to attend to the outcomes of creative effort in relation to their impact and particularly in relation to education. A focus on ‘wise creativity’ has been developed by Craft (2006, 2008) further articulated by Chappell et al., (2011) and by Chappell and Craft (2011) into wise, humanising emphasising collaborative and communal engagement with the ethics of creativity.

As has been seen, creativity encompasses many aspects of engagement and learning. Broadly, however, creativity is increasingly understood as social, as ethically situated, and as concerned with both paradigm shifts and the everyday.

A2. Creativity, innovation and learning
Drawing across the nine paradigms articulated in A1., researchers have identified that many factors can influence the creativity of individuals (though as Cropley and Cropley, 2008, show the research area is complex and contradictory); these can be grouped into cognitive, conative, and environmental (Amabile, 1983; Lubart, 1994; Sternberg and Lubart, 1995)

A2.1 Cognitive factors
Factors such as intelligence and knowledge can influence creativity. Some years ago, Guilford (1950), noted that creativity involved certain abilities as sensitivity to problems, a capacity to produce many ideas (fluency), an ability to change (flexibility), an ability to reorganize, to deal with complexity, and an ability to evaluate. Fluency and flexibility later became a part of the Torrance tests in creative thinking (e.g. 1968).

More recently studies have explored the nature of the sub-processes involved in creativity (Lubart, 1994; Sternberg, 1999; Sternberg and Lubart, 1995). Between these sub-processes have been identified: - problem finding, problem formulation, and problem redefinition (Mumford et al., 1996a; 1996b) – the divergent thinking (the process of generating many alternative ideas), – the process of forming idea combinations through random or chance-based processes (Simonton, 1988), – the process of reorganizing information (Baughman and Mumford, 1995; Sternberg and Davidson, 1995), – perception and information encoding (Mumford et al., 1996a; 1996b), and – using heuristics (Langley et al., 1987). Mumford and their colleagues (Mumford et al., 1994) examine cognitive capacities that contribute to creative problem solving. They proposed a creative process model that organizes the sub-processes
involved in categorical structures (Mumford et al., 1991). Studies support the idea that the combination and reorganization of extant knowledge is used to generate new ideas or novel problem solutions (as it was demonstrated in the historic study of scientific revolutions) (Kuhn, 1970), but studies do not tell us how people go about combining and reorganizing existing concepts. For example, a study by Mobley, Doares, and Mumford (1992), provides some clues about the nature of the combination and reorganization process. They argue that knowledge structures reflect a categorical organization of facts and principles (Barsalou, 1983; Fleishman and Mumford, 1989; Owen and Sweller, 1985). A further approach to creativity involves problem solving by analogy, which is considered as a strategy to bring together two items and to emerge a third. This may be particularly relevant in science education where it might be argued that analogy is needed to transfer thinking from one area of learning to another (Gentner, 1983).

A2.2 Conative factors
These encompass personality, motivation and emotions. Among the personality traits important for creativity, research, especially in adults, points out perseverance, risk taking, openness to new experiences, individuality, and tolerance for ambiguity. For example, McCrae (1987), showed that the trait ‘openness’ interacts with the process of divergent thinking in order to make creative production possible. Other authors show that extraversion (Wolfardt and Pretz, 2001) and psychoticism (Eysenck, 1993) are positively and strongly associated with creativity. Amabile’s work theorised that extrinsic motivation is insufficient for creativity (Amabile, 1983, 1998, 1996) whereas interest in the activity itself is much more likely to facilitate it.

Rewards, according to Amabile, actually have a destructive effect on creativity in general, particularly, on higher-order problem-solving. Amabile argues that the more complex the activity the more likely extrinsic motivation will block creativity, for if students perceive their learning as simply something they have to get through in order to 'win the prize', this reduces their capacity to be creative. This is particularly relevant given the wider performative culture in which children learn across the world. Moneta and Sui (2001), in their exploration of the lack of creativity in the highly-extrinsically motivated education system in Hong Kong, confirm this.

Besides certain personality traits, motivation plays an important role in creativity. Studies suggest that intrinsic motivation (i.e. curiosity, etc.) contributes positively to creativity, whereas extrinsic motivation (prizes, awards, and praise from parents or teachers) sometimes is negatively related to creativity and indeed learning generally. More recently, studies have focused on the impact of emotional states on creative performance. However, the conclusions of these works are not consensual. The results of Isen and his colleagues (Isen, Johnson, Mertz et al., 1985; Isen, Daubman and Nowicki, 1987) suggest that only positive emotional states,
compared to neutral and negative ones, promote creative performance. While other authors have observed that the more negative emotional states encourage creativity. Zenasni and Lubart (2002) suggest that contextual variables may be the cause of these differences. Russ (1999) examined the links between creativity and emotional expressiveness in children aged 5 to 7 years old and found that the frequency of emotional themes and variety are correlated with measures of divergent thinking. In addition, emotional creativity seems, vary by gender. Averill (1999) showed that women are more creative than men – although a Polish study of almost 650 six-year-olds by Uszyńska (1998) highlighted no influence gender, school type or location differences.

A2.3 Environmental factors
These include the physical, social and cultural environment. In terms of the physical environment, one recent study suggests visible connection with natural environment, use of natural materials and less manufactured or composite surface materials, with use of visual detail and warm colours, seem to be important (Mitchell et al., 2002) whilst the values implied by the environment are highlighted by Moultrie et al., (2007). Socially, the family environment may play a role in the creative process. However the relationship with family environment is unclear. The role of schools and teachers is often emphasized in the development of creativity (Sternberg and Lubart, 1993; Csikszentmihalyi, 1996). Creativity is increasingly understood to be a social phenomenon – as discussed in A1.5. Culturally there is evidence of creativity being differently interpreted in the West compared with the East being seen more as about individualism in the West and the collective in the East (Kim, 2007; Ng and Smith, 2004; Rao, 2005).

A3. Creativity and innovation: distinctive concepts
In general, creativity can provide the basis for innovation; the result of creativity is innovation. Whereas, creativity is usually understood to be the construction of ideas or products which are new and potentially useful (Amabile, 1988), for example in social or monetary terms, innovation is the way in which ideas are brought to a profitable conclusion. The test of innovation therefore lies in its success in the marketplace of ideas, rather than in its novelty alone.

In a study conducted by Kahl, da Fonseca and Witte (2009), contemporary creativity research was investigated by conducting an analysis of 119 abstracts. The results show that the terms creativity and innovation are used interchangeably by some disciplines. According to Cohendet and Grandadam (2008), the creative individual is a creator or inventor, not an innovator. Innovation itself, relates not only to the novelty but also to its introduction into an existing social system (Fayolle, 2004: 79) but is of course distinct from creativity in that the system of values relates to the profitable application of ideas.
Craft (2005; 2008) has analysed the increasing link made globally between creativity and innovation, in ‘marketizing’ creativity (although she critiques this as problematic). Sawyer (2006) by contrast argues that education increasingly needs to address the needs of society in which innovation is a core dimension. Drawing on studies of improvisation he suggests educators should connect to research about creativity and collaboration to develop ways of educating that attend to the role of improvisation in learning. Improvisational teams, Sawyer argues, are what are needed in the global economy and this means teaching in ways that allow students to build knowledge collectively, engage in enquiry and in productive argumentation as well as externalise their own developing knowledge. Sawyer identifies implications for lesson structure, curriculum design and teacher preparation.

As regards creativity in the early years however there is little research on the nature of innovation – unsurprisingly, given its market-oriented focus. Thus – creativity and innovation overlap in relation to their source/impetus however whereas creativity may produce results which have a variety of forms of impact, the notion of innovation implies impact in an economic context.
B. Nature of creativity in early years

B1. Creativity in early years settings
When it comes to researching and defining creativity in the early years, the notion takes on a different emphasis with less of a focus on outcomes. Two aspects are explored here; research on creativity in early years settings and underpinning philosophies of early education and their articulation with approaches to creativity.

B1.1 Creativity research in early years settings
Of the nine major traditions or paradigms in studying creativity and the cross-cutting factors outlined in the previous section, some traditions have been immensely influential in general and within early years settings and classrooms, namely psychometric, personality studies, cognitive and humanistic approaches and to a degree psychodynamic approaches and their influence can be seen in early years contexts. Psychometric approaches to researching creativity in the early years have tended to be drawn upon more by Eastern early years focused researchers than by those in the West. Such studies reflect a positivist paradigm and use primarily quantitative research methods. By contrast, personality studies, cognitive approaches and humanistic approaches to researching creativity in the early years are more commonly found in Europe and North America and it is these that have been used more extensively in studies of young children’s creativity. More of these studies reflect an interpretive paradigm, using primarily qualitative research methods, or alternatively mixed methods.

As well as the cognitive, conative and environmental influences cutting across these paradigms for understanding and researching creativity is the **location of creativity in early childhood at the ‘everyday’ end of the spectrum** from ‘little c’ or everyday creativity (Beghetto and Plucker, 2006; Craft, 2003; Runco, 2003) to ‘big c’ or paradigm-changing creativity (e.g. Gardner, 1993; Csikszentmihalyi, 1996; Simonton, 1994). Another way in which this contrast has been described is as ‘personal’ creativity rather than ‘historical’ creativity (Boden, 2001, 2004), who highlights the role of exploration, new combinations and transformation in personal and historical creativity. Creativity is characterised as at the heart of what it is to be human by Robinson (2001) who emphasised the need for finding one’s own passion (Robinson, 2009) so as to make something of one’s life. This notion of creativity as self-creating also underpins Craft’s (2001, 2010) perspective on the guiding force of ‘little c’ creativity in learners’ lives. An expansion of this spectrum has been undertaken by Beghetto and Kaufman (2007) who distinguish between ‘mini-c’ creativity (focused on the intrapersonal, essentially meaning-making), ‘little c’ (everyday creativity) and ‘big c’ (eminent creativity). Later adding ‘pro-c’ i.e. (professional creativity), Kaufman and Beghetto (2009), working in the United States of America, tease out the fine line between novel and original understandings with reference to the learner, spurred on nearly sixty years later, by the influential address made by
Guilford (1950) to the American Psychological Association to which American researchers frequently attribute the rise in volume of creativity studies. Guilford urged psychologists to research the nature of creativity in children in schools and in particular to recognise the relationships between learning and creativity.

Research into everyday creativity in the classroom has been developed by academics in many parts of the world, although as Feldman and Benjamin (2006) note, much of this has been undertaken outside of the USA despite Guilford’s original American calls. Key work has been undertaken by researchers in England (Burnard et al., 2006; Chappell 2007a; Chappell et al., 2008; Clack, 2011; Craft, 1999, 2000, 2001, 2002; Craft et al., 2012; Craft et al., in press; Cremin et al., 2006) and Taiwan (Lin, 2010, 2011) all of whom have explored the concept of ‘possibility thinking’ i.e. posing ‘as if’ and ‘what if?’ questions in a range of early years and primary contexts and involving both solving but also finding problems (Jeffrey, 2006; Jeffrey and Craft, 2006). From their qualitative work undertaken in the interpretive paradigm the research team has highlighted possibility thinking occurring in learning contexts encouraging exploratory, combinatory play. Possibility thinking it is argued involves children engaging in curiosity-driven exploration generating and investigating questions generating novelty (Burnard et al., 2006; Craft et al., 2012; Craft et al., in press). The possibility thinking research programme includes a focus on pedagogical practices which seem to enable it (these are discussed in section B3.1). Doctoral studies are under way focusing on possibility thinking in the early years, primary and secondary context spanning Cyprus, (Gregoriou2, Aristidou3), England (McConnon4), Wales (Alderson5), Taiwan (Ting6) and studies have been completed on possibility thinking in the upper primary years in mathematics (Clack, 2011), dance (Craft and Chappell, 2009), and drama (Lin, 2010, 2011).

The published studies confirm and document possibility thinking as driven by children’s questions and responses in a playful and frequently narrative context, in which a leading question shapes both service questions (exploration of the leading question) and follow-through questions (involving micro practical steps to help explore the leading question). These explorations are often cast as stories involving relational engagement. Children behave with intentionality, are self-determined and use imagination. They innovate and take risks and are immersed in the creative process. Their creativity is framed by the degree of inherent possibility in the questions posed (from broad to narrow) and integrates personal, collaborative and collective engagement as follows:

---
2 Focusing on possibility thinking in museum education in upper end of primary schools in Cyprus
3 Focusing on possibility thinking in the context of drama in Cyprus
4 Focusing on the development children’s artistic identity as possibility thinkers in the early years in England
5 Focusing on possibility thinking in creative partnership in upper primary education in Wales
6 Focusing on possibility thinking in secondary art teacher training students in Taiwan
Figure 1: Features of Possibility thinking integrated (Chappell et al., 2008: 19).

The studies illustrate that nurturing children’s possibility thinking involves teachers providing an enabling environment, valuing children’s agency, standing back and offering children time and space, yet recognising when to engage playfully with children entering their narrative and imaginative worlds (‘meddling in the middle’ – Craft et al., 2012) - explored further in B3. The construct of possibility thinking is informed by the cognitive and humanistic paradigms in particular in seeking to develop a model of creative engagement in young children and highlighting the self-realisation involved in creative endeavour. It also draws from the social-personality tradition in seeking to identify aspects of the socio-cultural content which seem to support creativity.

Also in England, Claxton (2006) has sought to conceptualise creativity as neither ‘light relief’ or ‘moments of illumination’ in problem solving but rather as ‘thinking at the edge’ (TATE) with delicate attention to the evolution of hazy and pre-conceptual ideas. Claxton argues that some forms of learning contribute to this evolution and that TATE might form the heart of learning how to learn, enabling thinking dispositions to be cultivated.

Jeffrey and Woods (e.g. 2003) also in England have explored everyday creativity in a more general sense in the primary classroom exploring ways that children’s creativity is manifest and what enables it. They highlight four key features of creativity in the primary classroom in relation to children and their teachers: a sense of relevance in the experience they are engaged in, control over its articulation, a feeling of ownership over their learning, and opportunities to innovate.

Wegerif (2005, 2010) and Vass (2007) in England and Rojas-Drummond et al., (2006) in Mexico meanwhile explore the nature of creative dialogue in the classroom, arguing that dialogic engagement is necessary to and inherent in everyday creativity in the classroom with implications for teachers. Their work, mainly undertaken in upper
primary classrooms, reveals inter-subjective co-construction and thus collaboration, in the context of shared social ground rules in the most successful creative dialogues in the classroom. In the United States, Paley (2001) has explored how children engage in both ‘what if’ and ‘as if’ creative and imaginative exploration demonstrating the delicate dynamics in the playful dialogues of the classroom.

**B1.2 Integration of creativity and child-centred philosophies**

Creativity has long been associated with a range of child-centred philosophies from European and North American thinkers as far back as the eighteenth century which have informed approaches to early years education. Framed by the 18th century view from Swiss philosopher Rousseau of the child as open, innocent and curious, and fuelled by the 18 to 19th century democratic and progressive ideas of the Swiss philosopher Pestalozzi, particularly influential thinkers included Dewey in America, Fröbel in Germany, Owen and Isaacs in England, Steiner in Austria and Magaluzzi in Italy. Each of these thinkers has had a worldwide influence on early years provision. Montessori, Fröbel and Steiner set up their own philosophical versions of early childhood education, in; Owen initiated the English nursery school system, and further English pioneer Isaacs emphasised the need for children to be able to move around freely in a learning environment; McMillan (McMillan, 1923) developed principles of nursery education to nurture the imagination, which integrated health care, nourishment, hygiene, exercise and fresh air, together with unrestricted access to play areas and gardens without a fixed time schedule. Malaguzzi theorised and helped develop the Italian pre-schools in the northern town Reggio Emilia. American philosopher Dewey’s ideas about balancing the children’s interests with the curriculum to be introduced, helped to further develop experiential learning approaches.

What these philosophies all share in common is a commitment to and belief in the importance of experiential learning approaches which inherently open up more opportunities for children to explore alternative possibilities. Beginning from a view of children as active, curious meaning-makers, each of these theorists constructed their own particular slant on how to nurture the learning of young children. They share in common a concern to offer children physical, hands-on opportunities in which they can make choices and build mental and practical connections between ideas, engaging in activity both indoors and outside. These theorists each emphasised in their own unique way, the importance of access to stimulating colours, textures, materials and opportunities for imaginative physical, social, mental and to some degree in the case of some, spiritual activity alongside the development of literacy, numeracy and other capabilities. Early years practice in Europe, North America and Australasia was influenced in the mid to late 20th century by the ideas of Piaget (whose theories of child development emphasised the need for children to have choice in selecting practical opportunities to handle natural and synthetic materials and to construct
understandings both indoors and outdoors), by Vygotsky (who
highlighted the social context in extending the ‘zone of proximal
development’ in learning) together with Bruner (who recognised the
nature of ‘scaffolding’ by more experienced for less experienced
learners). Inherent in these child-centred philosophies was the principle
of enabling exploration, through playful engagement in which children’s
choice-making played an important role, on the basis that exploratory
playful and practical experiences enable children both to make, re-make
and refine meanings and to transform these.

Inherent, then, in these exploratory, playful approaches to learning is a
view of the child as creative in the sense of being a constructor of
personal and shared meaning (Craft, 2005).

B2. Conceptualisations of creativity in curricula
Epistemologically, creativity in education is often framed in one of two
ways (Gibson, 2005). Firstly, creativity in education can be seen through
an instrumentalist perspective which sees creativity as a skill that should
be developed as a route towards innovation and building a ‘knowledge
economy’. Creativity understood through an instrumentalist
perspective is perhaps most closely informed by the cognitive, psychometric and
confluence paradigms discussed above. The second way that creativity is
often interpreted in education is through the notion of romantic ‘self-
actualisation’ and is tied in with a democratic ideal of creativity – that
creativity is something that we are all capable of and that creativity is an
important part of childhood development and relates to the paradigms
discussed above of ‘humanistic’ and ‘socio-personality’ approaches to
creativity.

Running across and relevant to both these frames or paradigms of
creativity, the instrumentalist and romantic self-actualisation, is the
pragmatic paradigm discussed above. While instrumentalism and
romantic self-actualisation are not dualistic or mutually exclusive per se,
they do perhaps have competing interests in school curricula. According
to practitioner perspective, mystical, psychodynamic and evolutionary
paradigms may be implicit in either approach, the instrumentalist or
romantic self-actualisation. Within these two epistemological framings,
there are also a number of ways in which creativity evidenced in
education is discussed. These discussions focus on the characteristics of
creativity and, like the epistemological foundations, the ultimate purpose
of what is being evidenced.

Banaji and Burn (2010) examined these various discourses of creativity
and grouped them into what they describe as nine different ‘rhetorics’ of
creativity:

- creative genius;
- democratic and political creativity;
- ubiquitous creativity;
Task 2.3: Literature Review of Creativity in Education

- creativity as a social good;
- creativity as economic imperative;
- play and creativity;
- creativity and cognition;
- the creative affordances of technology; and
- the creative classroom.

Creative genius focuses mainly on acts that are widely accepted as creative or ground-breaking. These might be movement-defining works of art, pieces of music or scientific discovery. When considering creativity in education, this rhetoric is perhaps less appropriate. The second rhetoric identified, ‘democratic and political creativity’, refers to the culture and politics in young people’s construction of identity. However, Banaji and Burn suggest that limiting the notion of creativity to activity linking identity construction with cultural knowledge limits creativity to the arts; an idea from which recent educational research has sought to distance itself. The remaining rhetorics however are appropriate for discussion in terms of creativity in education, and can broadly be split into the two epistemological positions described above. Reflecting the instrumental epistemology, we can see the rhetorics of creativity as social good (well-rounded individuals contribute more to society), creativity as economic imperative, and creative affordances of technology (towards building a ‘knowledge economy’). Ubiquitous creativity, play and cognition can all be seen as reflecting the idea of romantic self-actualisation. The notion of ubiquitous creativity, that is, creativity is something that we are capable of, ties in neatly with the self-actualisation emphasis. Similarly with play and cognition, which suggest that creativity is tied within the act(s) of individual(s) rather than related to any wider sense. The creative classroom is perhaps a little more difficult to place as it may contain elements of either or both perspectives/epistemologies depending upon the interpretation or ultimate goal. If the goal of the creative classroom is to produce ‘creative individuals’ then it could be situated within an instrumentalist epistemology, whilst if the goal is self-expression then the creative classroom can be seen to be driven by the romantic individualism.

Features of each epistemological framing can be found in the various paradigms of creativity discussed above in section A1. Table 2 below illustrates this in table form. Table 2 also shows how features of the two epistemological framings are evidenced in the rhetorics outlined by Banaji and Burn (2010).
<table>
<thead>
<tr>
<th>Research Paradigm/ applied discourse in education</th>
<th>Epistemological framing: Instrumentalist</th>
<th>Epistemological framing: Romantic Self-Actualisation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paradigm</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Psychometric</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Confluence</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Humanistic</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Socio-personality</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Pragmatic</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mystical</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Psychodynamic</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Evolutionary</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Discourse</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creativity as social good</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Creativity economic imperative</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Technological affordances</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Ubiquitous creativity</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Play</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Cognition</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Creative classroom</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 2: Paradigms and Discourses of creativity related to instrumentalist and self-actualisation framing of creativity in education.

Having positioned this theoretical discussion, it is of course important to look for empirical evidence to support the claims. One particular problem with this is that no curriculum that has been examined in this literature review is entirely situated within the instrumental or romantic framework and while they may tend toward one epistemological view, curricula often show evidence of both these epistemological standpoints.

Of course, the way in which creativity is interpreted (and indeed the way in which any curriculum is constructed) by governments, regional, local and school policy makers is inextricably linked to political aims and motives. Both epistemological views may be politically attractive – the first may be portrayed as “good for the nation or for Europe” while the second may be seen as more child-focused – and thus presenting both in the same curriculum could be politically beneficial. Thus while there are issues with both of these positions, both from an epistemological perspective and from a pedagogical and pragmatic perspective, curriculum documents from each of the countries involved appear to
reflect the discourses or rhetorics drawn together by Banaji and Burn (2010), as is described in the following section.

B2.1 European examples
As noted above, curricula may show characteristics of both epistemologies. In many cases it may be possible to highlight examples within curricular documents that provide counter examples, however in this section the discussion is on the perceived dominant epistemology in the curriculum of each country involved in the project.

Looking firstly towards the instrumentalist approach, there are number of reasons why an instrumentalist epistemological interpretation of creativity may be evidenced in a curriculum. Potential reasons may be efforts to address perceived national poor performances in international comparative tests, a national desire for economic improvement or for technological advancement. Indeed, there are a number of ways in which this may be justified.

Instrumental creativity can be seen in the English and Welsh curriculum. Since the mid-to-late 1990s, what has been described as the ‘creativity agenda’ has been a key part of education in the UK (Burnard, 2006). That is to say, there was an espoused emphasis on ‘creativity in education’ throughout this time from the Government. However, the interpretation of creativity was less clear and much debate has ensued.

What is less debatable is the nature of the curriculum, introduced in the late 1980s due to perceived ‘falling standards’ and revised a number of times in the last 20 years. The curriculum is heavily content-laden and has been described as an ‘industrial trainer’ curriculum (Ernest, 1991), that is, one that is specifically designed to provide a prescribed set of skills to children. It could be argued then, that any creativity in this curriculum must be inextricably tied to this ‘industrial trainer’ notion. As the industrial trainer is heavily focused on providing skills for industry, it is possible to identify an instrumentalist notion of creativity in this curriculum, with creativity seeming to be part of the ‘economic imperative’ rhetoric discussed by Banaji and Burn (2010).

Currently however, education in the United Kingdom is in a somewhat state of flux, with changes in both the political and financial climate leading to perhaps inevitable changes in curriculum. Ideologically however, the shift that is to come may be somewhat disturbing for researchers in creativity in education. While economic and industrial advancement has been seen almost internationally to be driven by creativity, the current government in the UK appears to see an emphasis on facts and knowledge as the economic imperative for long term success and improvement.

There is an apparent perception by the current UK government that there is a duality between attainment and creativity in education and it is predicted that this will be reflected in the forthcoming curriculum. ‘Creativity’ it could be argued, is seen by those in power as some woolly term and as synonymous with not learning ‘the basics’, despite the
extensive research over the last ten to 15 years in the UK that has sought to dispel this myth; much as research in the 1980s dispelled the myth of ‘progressive education’ allegedly ‘failing’ children in the 1960s and 70s. What this means for schools is yet to be ascertained.

The curriculum in Greece can also be framed in an instrumental epistemology. While no definition of creativity is given in the curriculum for teachers, creativity is defined as an outcome, either as a characteristic of children or of their work. That is, creativity is interpreted as a skill that children should attain, much like learning a mathematical skill. In this way, the curriculum is tied in with cognitive notions of creativity a central feature of the instrumental epistemology described above.

On the other side, there is the creativity as romantic self-actualisation epistemology. Again, there are a number of reasons why this might occur in a curriculum. Potential reasons for this may be due to educational ideologies (e.g. child-centred learning) or an emphasis on a skills-based curriculum (versus facts or knowledge-based curriculum).

A self-actualisation epistemology can be seen in the incoming curriculum in Germany where there is a changing emphasis from a facts-based curriculum to a more skills-based curriculum. In the new curricula, “Standards”, instead of putting an emphasis on content knowledge (as a basis for further understanding and transfer), competences/skills are announced which will have to be learned by the students. Each individual school can then decide which contents/themes they teach in order for children to learn the prescribed skills. Here then we see an epistemology that is largely focused around a self-actualisation rationale. The rhetorics of creativity in this curriculum appear to be creativity as ubiquitous, creativity and play and creativity as social good. Both the curricula from Malta and Romania can also be interpreted as having a self-actualisation approach to creativity, with Malta encouraging an aesthetic interpretation of creativity and Romania appearing to have a values-based curriculum.

Two curricula, from Belgium and Portugal, appear to show strong signs of both epistemologies, making both epistemologies ‘dominant’ in the curricula. As noted above, while the instrumentalist and self-actualisation epistemologies can be presented in a way that positions them as dualistic, this is not necessarily the case.

The best example of this appears in Government documents from Belgium. In areas of Europe where, for example, space or resources are limited, the notion of ‘creativity as economic imperative’ and ‘creativity as social good’ often comes to the fore, linked closely to an instrumentalist approach which sees creativity as tied to quantifiable outcomes. An example of this may be seen in Government documents from the Flanders area of Belgium, which discusses creativity in the context of entrepreneurship and innovation (Flemish Government, 2006). In this document, creativity in education is seen as in important part of being
able to “participate in a multicultural, democratic society”. Here, creativity is presented as context free, that is, it as skill that can be transferred across multiple domains – from economic and business domains to the social and cultural. However, in the early years (FMET, 2010), there is also an emphasis on encouraging the self-expression and curiosity of children through creative activities led by the children’s interests. Here we can see an approach that is more self-actualisation that instrumentalist in its nature. It is possible to critique this is two ways. The first would be to suggest that the curriculum is admirably flexible in allowing or encouraging creativity to be interpreted in a number of ways, the second would be to critique as potentially incoherent and internally contradictory. A closer reading shows that this is not the case and that definitions or interpretations of creativity change as children get older and progress through the education system. This seems to be a commendable approach to take.

Indeed, creativity in education is not however of primary concern in all countries’ schooling and indeed not all countries are explicit in the way they deal with creativity in their curricula. Indeed, the curricula from three countries in the research group make little or no mention to creativity – none of Finland, France or Portugal are explicit in their approach to creativity in education. The Finnish curriculum for preschool education, which seems to be one year only, to prepare the 5-6 year old children for school, highlights creativity only implicitly, and focuses more on the importance of play as central to learning. While many researchers have related creativity and play in the early years, the Finnish curriculum does not do this explicitly, and it is therefore difficult to determine what approach they may take. This is further complicated due to the fact that curriculums in Finland are localised, that is to say every school has their own curriculum which may be far more specific in its educational content and pedagogical aims than national one.

From the literature consulted, it was not possible to draw conclusions with respect to four of the countries. In Portugal, neither of the two epistemologies appears to be dominant. The Portuguese curriculum makes no explicit reference to creativity and with the changing government, what is to occur in future is unclear. France does not seem to mention creativity in its curriculum and indeed there appears to be very little mention of creativity in any of the accompanying Government literature. As such, it is difficult to make a comment on epistemological nature or the rhetorics. From the literature available at the time of writing, it was not possible to draw conclusions on Scotland and Northern Ireland.

A summary of the above can be made in table form. The table below (Table 3) shows the main epistemology and rhetorics to be found in the curriculum documents from each country involved in the Creative Little Scientists project, and two further documents, the Reggio Emilia curriculum and Te Whariki from New Zealand, which are discussed in greater detail in B2.2.
<table>
<thead>
<tr>
<th>Epistemology</th>
<th>Rhetorics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrumental</td>
<td>Self-actualisation</td>
</tr>
<tr>
<td>Belgium (Flanders)</td>
<td>✓</td>
</tr>
<tr>
<td>England</td>
<td>✓</td>
</tr>
<tr>
<td>Scotland</td>
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<tr>
<td>Northern Ireland</td>
<td></td>
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<tr>
<td>Wales</td>
<td>✓</td>
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<td>Finland</td>
<td>✓</td>
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<tr>
<td>France</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>✓</td>
</tr>
<tr>
<td>Greece</td>
<td>✓</td>
</tr>
<tr>
<td>Malta</td>
<td>✓</td>
</tr>
<tr>
<td>Portugal</td>
<td>✓</td>
</tr>
<tr>
<td>Romania</td>
<td>✓</td>
</tr>
<tr>
<td>Reggio Emilia</td>
<td>✓</td>
</tr>
<tr>
<td>Te Whariki</td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 3: The perceived dominant epistemological foundation of each country’s curricular documents and the rhetorics that are apparent within them.

**B2.2 International examples**

Outside of the main partner countries, there are two key educational approaches or initiatives that have had an important effect on early years education. These are the Reggio Emilia schools of northern Italy and Te Whariki from New Zealand. They each present creativity in education almost solely contributing to children’s self-actualisation, with little to no emphasis on an instrumentalist interpretation of creativity. Similarly, they both place a strong emphasis on ubiquitous creativity, creativity as a social good and play forms a central part of their educational philosophies.
The main emphasis of the Reggio Emilia approach to education is to allow children to have control over the direction over learning with an emphasis on self-expression. In this approach, teachers are seen more as ‘guides’ and ‘co-learners’, learning with the children in their class rather than didactic instructors. Reggio Emilia is the only curriculum that discusses the rhetoric of a ‘creative classroom’ in any meaningful way. Indeed, the philosophy of Reggio Emilia schools describes the environment in which children are taught as ‘third teacher’. That is, the educational setting, be it the inside or outside, is vitally important to the children’s (and the teachers’) learning experience. This further taps into the notion of children using experience of sense as a means of learning. It is possible then to recognise many of the notions of romantic self-actualisation in the Reggio Emilia approach, and indeed a number of the rhetorics proposed by Banaji and Burn, such as the notions of ubiquitous creativity, play, and the creative classroom.

Te Whariki (1996) comes from New Zealand and has had an impact on early years education around the world. It places a strong emphasis on creativity and (self-) expression in young children, (Strand 4) and on ‘empowerment’ in children that allows children to “understand their own individual ways of learning and being creative” (:40). Unlike Reggio Emilia, which places a strong emphasis on the arts, Te Whariki is less restrictive and suggests that creativity may apply extends “to challenges and changes to environments, rules and ideas” (:81). The self-expression, empowerment and emphasis on the individual all point strongly towards a self-actualisation epistemology and as with Reggio Emilia, emphasise the ubiquitous and play rhetorics of creativity.

B2.3 Approaches to/conceptualisations in relation to pedagogy
It is widely recognised that culture, policies and curricula influence both the content (Wollons, 2000) and the framing of the early childhood curriculum and thus teachers’ pedagogic practice. Pedagogy therefore needs to be studied in cultural context and understood in relation to this and individual teachers’ underpinning attitudes and beliefs. In a naturalistic study of two pre-school teachers in Iceland, Einsdottir (2003) examined the principles underlying their work and found their practices influenced by their educational beliefs and views on child development, though they found this hard to verbalise. The two teachers’ goals were largely similar, focused on play, happiness, social skills and the development of self-control, though these were achieved in different ways; one through goal-orientated education influenced largely from US literature, the other through less structured approaches, encouraging freedom and creativity. Another empirical study of the stance of teachers teaching written and musical composition in England (with 4-14 year olds), also showed that values are highly influential in guiding how pedagogy is conceived, how classrooms are resourced, how ethos is developed, and how tasks are constituted (Craft, Cremin, Burnard and Chappell, 2007). The teachers working with children aged 4-7 years, influenced by strong child-centred perspectives, appeared to expect and
value creative learning as a formative part of child development. However, as the children grew older, the teachers’ values were reflected in the nature of the tasks offered, with diminishing opportunities for agency, collaboration and exploration, and an increase in valuing children’s independence in performing, creating and reflecting with reference to the curriculum and external assessment. By highlighting teacher stance, this study offers evidence of the not inconsiderable significance of teacher’s dispositions and attitudes on the nature of task construction and pedagogic practice, and shows that teachers may inadvertently constrain children’s creative learning. In seeking to explore the practices and values of primary teachers in nurturing creativity, Forrester and Hui (2007) also found that pedagogy can not only enable, but may additionally form a barrier to student creativity.

In a study of creative pedagogy undertaken in England, the practices identified which nurtured children’s possibility thinking (of standing back, profiling learner agency and creating time and space) were clearly underpinned by the teachers’ conceptions of children as thinkers and of learning as a process of discovery (Cremin et al., 2006). These pedagogues often led by following, creating flexible maps as they travelled, and fostering a high degree of child ownership of learning. It appears that these teachers were influenced by constructivist views of learning; viewing learners as active constructors of meaning, and positioning themselves as facilitators, seeking to interest and engage the young through using open ended processes. However, the beliefs that individual teachers possess do not always fall under one particular theoretical approach, and furthermore external factors such as high stakes assessment can serve to compromise professional practice and create contradictions between teachers’ reported beliefs and their practice (English et al., 2001). Goldstein views such inconsistency in early childhood education as inevitable – “a fact of life in the open-ended, complicated teaching profession” (1997: 21), yet it can create tension and may evoke mixed messages about what is valued or sought (Smith and Croom, 2000). As Alexander (1997) posits, teachers’ values are central and are made manifest in learning contexts and tasks and also need to be translated ‘into meaningful learning for each child’.

In the research literature on creativity in education, two particular foci have gained considerable attention in research and policy contexts in recent years: teaching creatively and teaching for creativity. The former is arguably teacher centred whilst the latter is focused more on increasing creativity in general and in relation to fostering students’ creativity. In exploring the relationships between these foci, Jeffrey and Craft (2004), based on ethnographic data of an infant school, note that the two are closely related; teachers teach for creativity and also teach creatively as appropriate and sometimes do both simultaneously. Furthermore, teaching for creativity often arises spontaneously and is more likely to arise from contexts where teachers are teaching creatively. In this regard it should be recognised that children model themselves on
teachers’ behaviours and even if the intention to teach creatively is not explicit, children may still imitate their teacher’s creative stance. Another concept in the ascendant internationally is creative learning, which although contested, is now gaining international recognition as a term to imply the fusion of these two foci (Sefton-Green, Thomson, Jones and Bresler, 2011). Sefton-Green et al., suggest that the term and the empirical studies which seek to document and understand it, captures a ‘spirit of change at individual, classroom and even at whole institution or system level’ (2011: 7). They perceive the term attends to both teaching and learning, and connects to questions about the purpose of education for individuals and society as a whole. Due to the emergent nature of this term and its multiple manifestations we do not address it specifically in this subsection; rather we focus more clearly on creative pedagogies.

Whilst Dezuanni and Jetnikoff (2011: 264) view creative pedagogies ‘as both the imaginative and innovative arrangement of curricula and teaching strategies in school classrooms and the development of students’ creative capacities’, for the purposes of this section of the review we focus on teaching strategies which are documented as fostering children’s creativity. We explore the research literature with a view to identifying the core features of these. The research into people’s perceptions of creative educators (e.g. Fryer, 1996; Beetlestone, 1998) is not examined in depth here, in part as this tends to result in long lists of particular character traits which such teachers possess. Though it is worth noting that in drawing together these studies, the propensities recorded include: curiosity, independence, confidence, enthusiasm and commitment, the capacity to become preoccupied, persistence and assertiveness, as well as domain expertise and a tendency to be unconventional. Creative teachers are also noted by many writers to be comfortable with risk taking in both their private and professional lives (Boden, 2001). Arguably they are at ease with demonstrating their own creative engagement and exposing the ambiguity and uncertainty inherent in creative endeavour (Halpin, 2003), they are also likely to perceive failure as a learning opportunity. Writers also emphasise the combination of childlike play and exploration with adult-like self-awareness, and stress that such teachers are curious individuals (Richart, 2002). In addition, Woods and Jeffrey (1996) highlight the humanist approach of creative teachers, their openness to emotions and feelings, and the strong moral and political investment in their work.

In connecting to the work on the key characteristics of creative educators, Prentice (2000), reviewing early years practice at the turn of the century, highlights the need for creative teachers to show ‘cultural curiosity’ and engage themselves in playful learning, remaining open to children’s ideas and using a flexible and creative pedagogical style. Though he did not expand upon the nature of this style, subsequent studies have sought to do so, both affirming and extending the aspects of creative pedagogic practice noted earlier by Woods (1990) and Woods and Jeffrey (1996), namely: relevance, control, ownership and
innovation. It is to a summary of the key features of creative pedagogic practice evident in the research literature that we now turn, recognising that the studies examined in this section of the review are mostly empirical in nature, and make use of close observation and analysis of classroom practice and/or ‘creative teachers’; much of this work, as will be seen, draws upon case study accounts of small numbers of teachers’ classroom practices.

B3. Conceptualisation of creativity in practice

B3.1 Features of creative pedagogies

B3.1.1 Exploratory contexts which offer scope for deep play and immersion

Most of the empirical studies focused on teachers’ creative practice suggest that open ended exploratory contexts are well suited to fostering learner creativity; nearly all stress the significant role of play within these (Jeffrey, 2004; Burnard et al., 2006; Bonawitz et al., 2011; Cremin et al., 2006; Einarsdottir, 2003; Fawcett and Hay, 2004; Poddiakov, 2011). It appears that supported by the pedagogic space and scope offered for exploration, the children in these studies often travelled further than usual in play and in such contexts behave ‘a head taller than themselves’ (Vygotsky, 1978). In these playful situations, which were mostly purposely unstructured, the children extended boundaries and explored with interest and engagement. The young learners’ affective engagement in this ‘third area’, as Winnicott (1971) calls the deep play of childhood, appeared to prompt an openness which their teachers frequently sought to build upon. The work of Laevers (2000, 2005) in Flanders is also influential in this area, based on the Experiential Education project, Laevers argues that at the core of a quality education approach is the creation of playful learning contexts which foster deep learning; such learning he posits ‘affects the deeper structures on which competencies and dispositions are based’ (2000: 20).

In seeking to interrogate the similarities between play and learning, Samuelsson and Carlsson (2008) comment that ‘pedagogy should not separate play and learning but draw upon the similarities in order to promote creativity in future generations’. They suggest the similarities include: children’s experience as a point of departure, discernment, simultaneity and variation as key-factors and meta-cognition, meta-cognitive dialogues and meta-communications. The power of play is also highlighted in Reggio Emilia’s constructivist view of learning, this often involves investigating the environment (Edwards, Gandini, and Forman, 1993), and responding to provocations (Rinaldi, 2006). In a case study of two Finnish pre-school teachers, Einarsdottir (2003) affirms that play and child-initiated activities characterise the pedagogical work of these two professionals, both of whom it is argued, are typical of teachers of this age group. This study underscores the importance of play and the idea that children learn through play. In seeking to conceptualise playful
experimentation, which most scholars perceive is inherent in all young children's activity, Poddiakov (2011) asserts there are two main types of experimentation in the classroom which teachers need to foster – ‘personal experimentation [mental]’, aimed at discovering relations and the quest for new knowledge and ‘utilitarian experimentation [physical]’ aimed at solving practical tasks. Poddiakov also proposes a third 'special' type of experimentation ‘social experimentation’, which he suggests involves trying out forms of behaviour. The first two at least can be seen as forms of possibility thinking and connect strongly to on-going empirical work in the UK (Burnard et al., 2006; Cremin et al., 2006; Craft et al., 2011).

Notwithstanding this recognition of playful contexts as learning contexts that foster creativity, much depends upon the teacher’s role. In a quasi-experimental study undertaken with pre-schoolers in a science museum, Bonawitz et al. (2011) investigated the implications of explicit instruction on exploratory play. On the basis of their findings, the team claim that teaching children constrains their exploration and discovery, since even the children not being explicitly taught in this context, extended their assumptions about pedagogical situations from overhearing adults’ comments and demonstrations to other children, and they adapted their behaviour accordingly. As a consequence, the researchers suggest that such ‘pedagogy promotes efficient learning but at a cost: children are less likely to perform potentially irrelevant actions, but also less likely to discover novel information.’ (2011: 322). Their work on the ‘two-edged sword of pedagogy’ has implications for teachers, for example it may be that even as simple a recourse as delaying instruction until the learner has had a chance to investigate on their own could promote innovation and discovery. There is scope for work within the project Creative Little Scientists to investigate this issue further.

B3.1.2 Flexibility, time and space
Pedagogically, the evidence suggests that creative teachers are assured and leave space for uncertainty and the unknown (Claxton and Lucas, 2004). Their flexibility is a commonly held characteristic (Sternberg, 1999; Richhart, 2002; Nickerson, 1999; Halpin, 2003), and relates not only to professionals’ capacity to remain open to the unexpected, but also to their commitment to allow sufficient time and space for children to explore and experiment, though it should be acknowledged that this does not imply the absence of any structure or support. This focus on providing space and time for experimentation has been affirmed as a distinct pedagogic practice which nurtures possibility thinking at the core of creativity (Cremin et al., 2006). It was also noted in the European CLASP project (Jeffrey, 2005). In the former, the provision of ‘stretchy’ time in each setting encouraged children’s full immersion in extended playful activities and, alongside the enriched and mutually-owned space, appeared to motivate and involve the young possibility thinkers. The teachers created the time and space for children to explore their environment and the materials provided, encouraging
problem solving and problem finding activities and actual and mental play (Joubert, 2001). In the latter, Jeffrey noted that considerable time was afforded ‘open adventures’, and that these exploratory opportunities enabled the young to experiment, push boundaries and take risks. Central to this was another common pedagogical feature that of fostering control of learning and ownership of knowledge on the part of the child.

B3.1.3 Profiling agency
A critical part of creative teachers’ practice focuses on the development of agency and ownership, such that the child learns for himself, not for the teacher or their parents and develops self-determination and control (Craft et al., 2012; Cremin et al., 2006; Cremin, Barnes and Scoffham, 2009; Jeffrey, 2005; Raggl, 2006; Sugrue, 2006; Woods and Jeffrey, 1996). These studies collectively suggest that teachers’ trust, interest and respect for children’s ideas facilitate young people’s sense of autonomy and the degree to which they are in control of their own learning. Rather than leading, the teachers in these studies often set open ended tasks which the children undertook in groups or pairs and which they organised themselves, following their own ideas and interests. Raggl’s report (2006) of creative learning in a primary school in Austria for example, highlights the learners’ independence and control as co-creators of the learning situation, though as McWilliam (2008) acknowledges, for decades teachers have been expected to position themselves as ‘custodial risk minimisers’ and thus may have limited the autonomy and agentic space offered to children.

In the possibility thinking studies, the teachers prioritised learner agency (Cremin et al., 2006; Craft et al., 2012) and expected high degrees of independence of even the youngest learners. Control was frequently handed to the children who initiated their own activities or made their own choices within a broad focus. Their teachers considered it was of considerable import that the children were involved in co-constructing and co-authoring their work, thus enabling them to exert greater control over their learning. In order to ensure the children developed independence and agency, the teachers often employed reverse questioning, passing the problem back to the learners. However, in ethnographically explicating the journey of an Irish group of primary aged learners, (who had special needs and were taught both in a ‘special unit’ and in mainstream classes), Sugrue (2006), found that the children’s increased responsibility and agency observed in the ‘special unit’ was often disabled in the more formal mainstream classes. These classes did not provide space for creative learning. This work highlights the tension between structure and agency and the impact of teachers’ pedagogic practice and provision on the creative learning. It also links to the instrumentalist versus romantic points of view examined earlier. A study of progression in creative learning additionally demonstrated the potentially constraining nature of some tasks, which, when tightly framed and overseen, reduced the potential for learner agency (Craft et al., 2007). Whilst teachers are clearly volitional in their
own classrooms, they are also expected to deliver the given curriculum and in England at least the performative agenda, prescribed curricula in maths and literacy and on-going inspections related to standards (as assessed on national tests) has undoubtedly reduced the space and time and autonomy and trust afforded to young people, particularly after they leave the EYFS in England (Troman, Jeffrey and Raggl, 2007; Troman, 2008). Though as Jeffrey and Woods (2006) have shown, a constraining national agenda may prompt some professionals to respond with creativity and flexibility in order to retain their values and creative practice.

This emphasis on agency and independence should not however be taken to imply that children are obliged to work alone, indeed many studies highlight the opposite and show the teacher positioned as an orchestrator of creative collaboration (Miell and Littleton, 2004; Sawyer and Berson, 2004; Vass, 2004). They note the significance of dialogue and collaboration as well as the benefits of unstructured group discussion in nurturing creativity in individuals. For example, in a report analysing ‘Haus der kleinen Forscher’ (the house of little scientists), which sought to enhance the technological, mathematical and scientific education for preschool children, Kramer and Rabe-Kleberg (2011) show that the children’s collaborations often display creativity, and also foster their effective task-management and scientific understanding. Creativity appears to be nurtured in this work through letting the children experiment collaboratively with one another relatively free from constraints. In their interactions, Kramer and Rabe-Kleberg argue that in these contexts, the young actively apply their knowledge to creatively solve problems and thus enhance their understanding of scientific processes. Though focused only in the pre-school years, this study appears highly significant for the current project which is exploring links between creativity and maths and science.

B3.1.4 Question posing and modelling curiosity

Questioning, Claxton (2001) asserts, means both the ability to ask good questions and the disposition to do so, which is sometimes called curiosity. Whilst it is widely accepted that young children are innately curious and seek to explore the world around them, it is also the case that as Nickerson (1999) suggests, the educational process can both inhibit and stifle their curiosity, their impulse to question and their engagement in mental play. The creative teacher is viewed by many scholars as one who frequently employs open ended questions, who finds problems and promotes speculation by modelling their own curiosity (Craft, 2002; Cremin et al., 2009; Fisher, 2003; Robertson, 2002). However a science study in the early years suggests that open ended questioning may be problematic for some children (Harris and Williams, 2007). Creative teachers arguably make use of open questions to promote deeper, transferable thinking and to invite learners to engage with problems of relevance to them. This can, it is indicated, improve standards of understanding and knowledge through increasing
metacognition (Shayer and Adey, 2002). In addition, the teacher who shows their own creativity by constantly questioning themselves is well placed to foster such an attitude in others, thus potentially generating the unexpected or the unusual and ‘developing intrigue’ (Poddiakov, 2011). Linked closely with the tendency to be curious and seek new learning for oneself is the professional confidence to deal positively with uncertainty and tolerate ambiguity (Sternberg, 1997; Halpin, 2003; Grainger, 2006). Such professional skills are of particular importance in changing policy climates and accountability cultures in which the setting of hierarchical targets is prevalent.

In arguing that question-posing and responding is the driving feature of possibility thinking, Chappell et al. (2008) highlight the significance of teachers offering leading questions, which their research suggests, are often possibility broad in nature. Such questions appear to provide the over-arching framework for the learners and to some degree lead/shape their possibility thinking, though it should be noted that in the study these overarching leading questions often followed an extended discussion with the children and were therefore responsive to some degree to children’s interest and motivations. However, in the episodes documented it was not only the teachers’ framing of the purpose of the leading question, but also their provision of space and time for exploration and development work that were critical in enabling children to possibility think their way forwards. Such pedagogic provision may have acted as scaffolds to support creative learning; the teachers’ questions too may be seen as supportive scaffolds (Bruner, 1986). This represents a reminder that the common features of creative pedagogical practice noted in this review do not operate in isolation.

B3.2 Making learning relevant

The relevance of the teaching to the learners, personally, socially and emotionally was seen to be one of the vital aspects of creative teaching in the early empirical work of Woods (1990) and Woods and Jeffrey (1996). They suggested that creative teachers help children see what is valuable about their work, perhaps through planning work in the context of its practical application and linking to their own talk and thinking about their learning- the development of metacognition. They also highlighted emotional relevance (Woods, 2001). Subsequently this work has been affirmed by other studies and the concept of relevance expanded to include developing work which is contextualized by real life applications and which offers the possibility for involvement with partners from the world beyond school, (Cockett and Cochrane, 2006; Fawcett and Hay, 2004). (See section on teachers as collaborators below).

Additionally, teachers are seen to make learning relevant by incorporating children’s prior-knowledge (Kramer and Rabe-Kleberg, 2011), by connecting to their cultural, social and linguistic assets (Moll et al., 2002), and by offering emotional space and considerable encouragement (Craft, McConnon and Matthews, 2012; Woods, 2001).
Furthermore, several researchers highlight that teachers, utilising the widely recognised power of narrative and dramatic storymaking, effectively make learning relevant by engaging children imaginatively and thus foster their creativity (e.g. Bruner, 1986; Cremin et al., 2006; Egan, 1988; Paley, 2001; Sawyer, 2004a, 2004b). The role of narrative as a playful imaginative context in which young children’s creativity can be nurtured is an area for potential exploration in both maths and science. It connects strongly to children’s emotional engagement in their learning.

It could be argued that emotional engagement is simply a requirement of good teaching, though Cremin et al., (2009) have suggested that creative teaching depends more upon emotional engagement and relevance because creativity is so closely bound up with meaning, linking this to Csikszentmihalyi’s (2002: 76) view that creativity is a ‘central source of meaning in our lives’. Identifying the purpose of the work may prompt the condition which Csikszentmihalyi describes as ‘flow’; one in which the participant becomes so involved in the activity that the sense of self is merged with it. Alongside physical activities, creative activities appear to be the main generators of the sense of flow in human beings (Csikszentmihalyi, 2000). The teacher has to ensure that such activity becomes self-directed if it is to be sustainable and self-direction seems to arise most effectively from activities and pedagogic practice which foregrounds personal significance, relevance and passes the locus of control to the learner (Woods and Jeffrey, 1996; Jeffrey, 2006).

Additionally, evidence suggests that creative teachers seek to make work relevant through making connections to their own lives and personalising teaching. They foster connection making and metaphorical thinking in the young through the use of metaphor, anecdote, visualisations and analogies (Heath and Wolf, 2004; Grainger et al., 2004; Woods, 1995). Connecting visualisations using memory or imagined worlds with a real problem can, Claxton and Lucas (2004) argue, result in highly original solutions. Again the role of the teacher modelling creative thinking is seen to be significant, as they ‘surf the inner net’ (Claxton and Lucas, 2004) aloud in order to demonstrate the soft focus and reflexive attention needed for creative thought.

**B3.3 Teacher as fellow collaborator: Balancing standing back and intervention**

As noted earlier, standing back has been identified as a core pedagogic strategy which nurtures possibility thinking (Cremin et al., 2006). What distinguishes this strategy is the position of the teachers, who prioritise stopping and observing, and listening and noticing the nature of the learner’s engagement. By being ‘one remove’ yet highly attentive, the teachers it is claimed, were able to notice any unusual or unexpected actions, behaviours or ideas suggested or enacted by the children. The teachers discursively positioned themselves as agents of possibilities; ‘what if’ agents’ (Cremin et al., 2006) and this, it is suggested, enabled the young to take up positions both as decision-makers and as agentic...
learners, utilising the time and space made available for them to explore and experiment. Figure 2 offers a representation of these interrelated pedagogic features which are claimed to support young possibility thinkers.

![Figure 2: Pedagogy nurturing Possibility thinking (Cremin et al., 2006, p116).](image)

The work of other scholars also highlights the pedagogic practice of respecting children sufficiently to stand back from their endeavours in order to observe their interests, needs and direction of learning and then build upon this (Fawcett and Hay, 2004; Rinaldi, 2006; Tobin, Hayashi and Zhang, 2011). This suggests that fostering creativity requires professional restraint and well developed skills of close observation. Kramer and Rabe-Kleberg (2011) also observe that when the teacher works mainly in the background, children create their own science learning processes in collaboration with other children. In the possibility thinking work, the teachers’ background role is not perceived as passive, rather the teacher observes actively in order both to enable the children to be decision makers and to learn about their thinking and their interests (Cremin et al., 2006). Hyvönen (2008) too highlights the role of teacher as ‘allower’, implying some degree of standing back and avoiding too much intervention, though he also mentions other roles such as leader, afforder, coordinator, supporter, tutor, motivator and facilitator.

However, in articulating their theory of early childhood education pedagogy, Samuelsson and Carlson (2008) argue that one of the main features of their ‘developmental pedagogy’ is the teacher focusing the child’s attention towards problems that arise and suggest that at times the teacher is more fully and playfully involved as a fellow collaborator and provocateur. Drawing on the philosophy of Reggio Emilia, Bancroft et al., (2008), also highlight the significant role of stimulus provocations.
triggered by adults as Craft et al. (2012) also do in their exploration of the balance between child and adult-initiated creativity in the early years. In this recent work, the teachers not only stood back from the learners but also at times played alongside the children as partners. As such they were often present ‘in the moment’, and effectively combined observing with intervention (see Figure 3). This connects to McWilliam’s (2008) conception of the ‘meddler in the middle’ and involved the teachers in working alongside with intense sensitivity as to appropriate interventions. This **positioning of the teacher as a fellow artist or at least fellow collaborator engaged in co-authoring** is in contrast to more traditional notions of power relationships in the classroom. Although historically the hierarchical model so familiar in later primary and secondary education, has not been as prominent in early years education (Smidt, 2006). There is however still scope for a closer examination of a more dialogical pedagogical model in which the teacher is re-positioned as a collaborator in the application and production of knowledge in maths and science classrooms.

*Figure 3: Pedagogy nurturing possibility thinking – (Craft, MConnon and Matthews, 2012)*

**B3.4 Reflection, feedback and critical evaluation**

As Sternberg (1997) points out those who work most creatively identify and reward creativity in others and thus the appreciation of their own creativity becomes a motivator in itself. **Positive affirmation of the creativity of the young** is seen to be a key part of the Pedagogista’s role (this is the professional who facilitates teams of educators who work in Reggio Emilia centres). These pre-schools in Northern Italy are distinctive in this regard, particularly in relation to the reflection and
documentation on learning (Malaguzzi, 1993; Rinaldi, 2006). Such reflection, in Italy and elsewhere, may take many forms, some teachers encourage creative reflection through drawing (Barnes, 2004; Heath and Wolf, 2005) while others highlight reflection through writing (Armstrong, 2006) or focus on the questioning of assumptions, redefining of problems and looking for what else might be possible (Richhart, 2002; Craft, 2000). Whether the children have expressed their ideas, verbally, in drawings or other ways, the teacher in focusing the young learners’ attention on how they think about something, fosters the children’s meta-cognition and in this way seeks to help make the invisible more visible and the implicit more explicit. This was also evident in a study by Williams and Cremin (2009) in which the teacher, focused on teaching the science of forces, profiled reflection and questioning, the ability to reflect upon and evaluate learning, and becoming more metacognitively aware. The metacognitive capacity of the six and seven year olds in Williams’ class in England far surpassed this practitioner’s expectations. The importance of meta-cognition, meta-cognitive dialogues and meta-communications are also seen as significant in relation to play and creativity in the work of Samuelsson and Carlsson (2008).

Additionally, professionals who value creativity are more likely to celebrate the children’s original ideas, suggestions and actions. Though as Sternberg (2010) recognises, teachers must enable learners to take responsibility both for their successes and failures, he suggests this must include teaching children to understand the non-linear nature of the creative process, the need to be self-critical and to take pride in their best work which demonstrates their creativity. Positive feedback was noted in Jeffrey’s (2006) work on creative learning, and also in a study of eight ‘creative teachers’ in a Creative Partnerships funded study in the UK (Cremin et al., 2009), as well as in a study of higher education lecturers who, in a not dissimilar manner to colleagues working with much younger learners, offered opportunities for reflection and regularly celebrated the creative contributions of their students (Grainger, Barnes and Scoffham, 2004). Boden (2001) too highlights the role of evaluation and feedback, but notes the need to avoid ‘premature criticism’ as this may curb creatively.

In contrast, researchers from the far East, posit that the notion that critical feedback quashes creativity is an unquestioned assumption promulgated in the West (Tobin, Hayashi and Zhang, 2011), and suggest that there exists in China a hybrid pedagogy that combines Chinese and Western pedagogical notions of creative practice and that at the heart of this lies constructive criticism (alongside an emphasis on collaboration). The Australian scholar McWilliam too perceives one of the key roles of creative practitioners, which as noted earlier she describes as ‘meddlers in the middle’ are as ‘collaborative critics and authentic evaluators’.

Critical evaluation of both process and product is perhaps an area for future exploration, alongside the cultural framing of creativity.
It is clear that teachers who allow space, time and freedom to explore possibilities, and who also afford support for reflection both between and within learners are likely to foster children’s assurance to evaluate and extending their thinking. The capacity to handle critical feedback may be easier where relationships of trust and mutual respect are evident, this links to the ethos of the classroom and the close relationships between creative pedagogical practice and an ethos which fosters creativity.

**B3.5 Ethos and relationships**

The dividing line between a creative pedagogy and a creative ethos in the classroom is difficult to draw. Several scholars stress the links between creative learning and emotional security (Halpin, 2003; Gardner, 1999; Woods, 2003) and there is evidence to suggest that children’s *creativity flourishes in situations where there are relaxed trusting educator–learner relationships and strong emotional security* where the role of the affect and children’s feelings play a central role (Craft et al., 2012; Jeffrey and Woods, 2003; Shayer and Adey, 2002). Additionally, research has shown that individual creativity is influenced by the ethos of the institution (Amabile, 1988); the school ethos influences that created by teachers in their classrooms and thus opportunities for creative teaching and learning (Cochrane and Cockett 2007). In Hong Kong, it has been shown through Vong’s (2008a, 2008b) research that leadership and the wider organisational climate of the school influences early childhood practice, impacting on the way creativity and innovation are received and developed. In schools with a secure ethos, features of creative practice such as foregrounding playful engagement, the speculative, the tendency to find problems rather than wait for them to be assigned and self-determination for example are noted. These features are recognised in many of the studies referred to above at the level of the classroom, yet relatively few of these studies afford much attention to the wider culture of the school in which the research is situated.

Creativity, it is argued, is enabled through play where the relationship between the learner and the teacher provides an environment that allows it, (for example, an *environment of not too much and not too little support, trust and acceptance*) such that the learner feels safe to play, sometimes alongside their teacher. Sawyer (2006) also argues that learning environments need to be designed in order to scaffold and support collaboration and ‘disciplined improvisation’ among all involved and Harrington (2007) in discussing creative ecosystems posits that since creative processes make psychosocial demands upon individuals and their support networks, a non-threatening atmosphere in which learners can take risks and make mistakes is essential. Additionally, the work of Kangas (2011) in Finland foregrounds the environment, it indicates that the ‘ideal creative and playful learning environment’ is one that fosters the use of diverse formal and informal learning places and spaces, and makes good use of new technologies. Such environments, she argues, based on primary phase data, enrich not only children’s creativity but
also their playfulness, physicality and overall well-being. This connects to Laevers’ (2000) work, and his conclusion that the quality of learning relates to the degree of ‘emotional well-being' and the level of ‘involvement’ of the young.

Some studies of **pedagogic partnerships between adults which seek to foster creativity** not only recognise the impact of ethos but also attend to their individual and collective pedagogic practices. In an early years study by Fawcett and Hay (2004), in which teachers worked with a variety of creative partners, the involvement and intense concentration of the young children was attributed to the strong ethos and relationships amongst children and adults. The reflective and dynamic debates between the artists and the educators was reported as rewarding for both, and contributed, it is suggested, to the development of ‘creative learning communities’ which fostered the creativity of all involved. Kangas (2011) also shows the significance of teachers fostering learning communities and positioning themselves within such communities as creative collaborators and arguably therefore ‘artists’. Increased attention has also been afforded the artistic engagement of classroom teachers in England too, though most of this work focuses on literacy, in primary (e.g. Cremin and Baker, 2011; Cremin and Maybin, in press) and in secondary schools (e.g. Walsh, 2007).

In England, although there is a tendency to dichotomise artists’ and teachers’ roles (Galton, 2008), new work is emerging around creative pedagogies of both teachers and artists (e.g. Heath and Wolf, 2004; Jeffery, 2006). Though this may have the effect of implying teachers themselves are primarily pedagogues not artists, even though pedagogy is arguably the art of the science of teaching and all teachers are potentially creative. In secondary art teaching in England a pedagogic turn that highlights the presentation of the teacher as an artist has been documented (Adams, 2011). This work suggests that the pedagogy of teachers who deliberately position themselves as artists and work alongside learners for the purposes of creative learning, is typically less didactic than usual and is ‘driven instead by a community, collaborative production model’ (Adams, 2011). The extent to which this is the case in early years mathematics and science teaching is not known.

B3.6 The challenge of orchestrating creative teaching
The challenge of orchestrating creative teaching and achieving a balance between structure and freedom in educational settings should not be underestimated. The ‘**disciplined improvisation**’ (Sawyer, 2004a, 2004b) of creative teaching makes high demands on teachers who seek both to utilise routines in the context of wider curriculum structures/ requirements and to work flexibly in order to offer creative opportunities to build new knowledge and understanding. Additionally, the question of the difference between creative teaching and ‘good teaching’ is an issue, perhaps as Cremin et al., (2009) argue the difference is one of emphasis and intention. These
researchers suggest that although good teachers recognise the importance of inventiveness, creative teachers see the development of creativity and originality as the distinguishing mark of their teaching; they are aware of, and value, the human attribute of creativity in themselves and seek to promote this in others.

However, the lack of recognition of creativity within policy documentation, the relentless quest for higher standards and the pressure to ensure curriculum coverage may prompt professionals to create pedagogic routines, boundaries and timetables which obscure the personal, affective and creative dimensions of teaching and learning, fostering ‘a mind-set characterised more by compliance and conformity than curiosity and creativity’ (Cremin, 2010:19). Such a mind-set may not only be adopted by teachers but also by younger learners, markedly reducing their sense of agency and possibility. Furthermore, as Hennessy (2003) observes some research suggests classrooms typically destroy intrinsic motivation and therefore creativity through expected evaluation, expected reward, deadlines, surveillance and competition. Although she shows that where choice is given, intrinsic and extrinsic approaches to motivating creativity appear to have an ‘additive’ effect nurturing creativity even in contexts which are challenging to its development (Hennessy, 2003). Whilst the curriculum can both constrain and enable creativity, teachers can and many do exert their professional autonomy to teach creatively and teach for creativity. There is clearly scope for international research which documents more closely such pedagogic practice and fosters creativity in science and mathematics, not only in the pre-school years, but across the age phases.

B4. Conceptualisations of creativity in relation to learning in early years

Creativity is frequently recognised as virtually synonymous in the early years with learning. Indeed both Craft, (2002, 2005) writing in England, and Beghetto and Kaufman, (2007) Kaufman and Beghetto, (2009), writing in the USA, recognise that making new meanings is a form of creativity in young children. These sets of conceptual work undertaken from a situated perspective, both recognise creativity in context.

From a developmental perspective, studies of creativity in children show a mixed picture. Early work by Torrance (1968) suggested the development of creativity might not be linear. Torrance’s (1968) results in a longitudinal study of a sample of 100 children showed poor performance on the fluency and originality of children between 9 and 10 years old. However this is not borne out by later research. For example, Runco and Charles (2000-2001) noted in a study of children aged 8-11 drawing on tests from Wallach and Kogan (1965 in Runco and Charles, 2000-2001) that originality and appropriateness of ideas increases with age. Lubart and Lautrey (1996 in Lubart, 2003), in a longitudinal study of 57 children between 8 and 11 years old, measured the creativity from
Tests of Creative Thinking Torrance (1976) and two conventional intelligence tasks classification of class inclusion (Bideaud and Lautrey, 1983 in Lubart, 2003). The results show a decline of creativity in one of the tasks of divergent thinking (new use of a cardboard box) in children 9-10 years while an increase was observed in the tests measuring logical thinking at the same ages. Similarly Lau and Cheung (2010) in a study undertaken with 2,476 Hong Kong Chinese students, found, using an e-version of the Wallach-Kogan test, a gradual but not smooth improvement. Children’s scores increased aged 9-10, decreased from 10-11, decreased from 11-12 and then increased from 12-13. The largest drop – from age 11-12, occurred at the point of transfer to secondary school. The study was consistent with a review of all such studies done to date (Mullineaux and Dilalla, 2009) which concluded children’s creativity continually increased, on average, with some troughs and peaks.

It should also be noted however that such studies of change over time are all based on the use of context-free testing which can be critiqued; this is further developed in section C which explores approaches to the evaluation or assessment of creativity. Such studies also focus on the manifest creativity of the individual, whereas other work focusing on creativity in the early years and primary education, drawing on the seminal work of John-Steiner, 2000), highlights the collaborative and communal elements of creativity interwoven with the individualised (Chappell, 2007a, 2008; Craft et al., 2012; Chappell et al., 2008).
C. How is creativity evaluated in the early years?

The development of approaches to enable the assessment of creativity is a European priority and formed one a focus during the 2009 European Year of Creativity and Innovation during which a conference was held in Brussels on the measurement of creativity. Preparatory position statements together with outcomes from the conference were published by the Joint Research Centre, European Commission (Villalba, 2008, 2009). As part of the conference outcomes, Hingel (2009) argued for the need to monitor creativity capability across Europe (through for example capacity for analogical and divergent thinking, risk-taking or openness) by developing a large scale survey applied across European member states which could provide evidence of progress over time.

Creativity as a foundation to innovation has also been addressed by the OECD7 (Looney, 2009) who analysed the tensions between high-stakes summative assessment with innovation and argued that it was possible to reconcile such testing through a range of strategies encompassing a wide range of performance measurements for students and schools, realigning standards and assessment and integrating assessment and learning and perhaps most importantly through staff taking appropriate risks to foster creativity and innovation in their institutions. Indeed, the OECD’s Programme for International Student Assessment (PISA) for fifteen year olds (introduced in 1997) seeks to provide comparative summative assessment information of older learners for educational policy making purposes focusing not only on the domains of knowledge seen as vital to effective citizenship in the 21st century by the participating countries, but also focuses on appropriate skills (Schleicher and Tamassia, 2003). It has strong international government support and there were 74 participating countries in the 2009 wave. PISA produces summative data through specially designed tests, and since 2003, problem-solving has been assessed within the context of using mathematics and science knowledge to solve everyday problems as part of the PISA assessment framework. Whilst these tests are for older students than those in the early years, the inclusion of problem solving highlights increasing concern within Europe to find ways of measuring complex skills in relation to traditional domains of knowledge. Work undertaken by OECD has focused on the development of a composite indicator for creativity (reported by Saltelli and Villalba, 2008). There is a clear recognition of the need to move beyond the pure acquisition of knowledge (Stewart, 2011). What is not yet in place is a way of assessing creativity in the context of other subjects such as mathematics and science, and it is not clear how this might develop; the European Commission’s Joint Research Centre probe was sceptical about the cost and effectiveness of using PISA or another international test (Villalba, 2008:33).

7 Organisation for Economic Cooperation and Development
Thus internationally the tension between formative and summative assessment in relation to assessment for learning vs. assessment for comparative purposes, is evident. Summative assessment is being used as a powerful tool for policy makers to know how children are doing, and to compare countries’ performances. Arguably, these large scale surveys are used to aid policy development, ensure preparation for adult life and influence national growth rather than formatively guide individual progress or development. It is possible, as Saltelli and Villalba (2008) argue, that measurement of creativity is vital in that the comparison between countries’ performances may provide insight into how key variables interact at a wider societal and economic level – for example, how the rise of the ‘creative class’ might relate to economic growth. They argue that a European creativity indicator should be developed – a challenge taken up by Kern and Runge (2008) who grouped thirty-two indicators for creativity which focus on social and economic factors, although the establishment of an intercultural notion of creativity is not yet under way (Hingel, 2009).

These international efforts reflect a concern with the nature, scope and potential for evaluating creativity and they are positioned in relation to a number of assumptions as the next section explores.

C1. Approaches to / conceptualisations of assessment

There are a number of different ways of approaching the conceptualisation of assessment of creativity, however there appear to be three fundamental points to consider. First is what is to be assessed (i.e. is creativity seen as a process, a product, or both?); second is who should be involved in assessment (i.e. should someone outside of the creator make that judgement or does the creator have a role to play) and finally; how is creativity assessed in practice (i.e. what tools or tasks are adopted).

There are two broad strands of creativity assessment, each of which has its own way of addressing the above three points. These can be characterised as psychometric approaches to assessment and componential approaches.

C1.1 Psychometric assessment

As indicated in Section A of this review, psychometric assessments of creativity stem from the early cognitive approaches to creativity that proposed that creativity was a general phenomenon, a ‘quantity’ that we each had (e.g. Guildford, 1950: 446), and innate - with the subsequent implication that some inherently had more than others and that it could be tested using psychometric instruments.

Seminal work on this was developed by Torrance (1966, 1974). His initial core creativity criteria of fluency, flexibility, elaboration and originality were, interestingly, adopted by the Scottish HMI Education (2006), as markers of creativity in schools. Usually assessed using standardized, criterion-referenced tests, focusing on the outcomes or products, student
creativity is scored by the subject completing a series of questions, and the final product then being rated, on a scale from low to high. The Torrance Tests of Creative Thinking [TTCT] were developed during the 1960s and 70s but which continue to be updated to the present day (Torrance, 2008). They are of two types, the figural test which uses three picture-based activities and devised for all levels of use from kindergarten to adulthood, which tests fluency, elaboration, originality, resistance to premature closure and abstractness of titles. The verbal test uses six word-based activities to assess fluency, flexibility and originality and can be used with children from the age of six to adulthood. The tests look to evaluate participants’ ability to generate many diverse ideas in response to a single stimulus, or ‘divergent thinking’. In the Torrance tests, children are encouraged to elicit the maximum number of ideas from a verbal or pictorial stimulus. As indicated in Section A, the criteria now encompass not four but five subscales for fluency, originality, elaboration, abstractness of title and resistance to premature closure.

The TTCT were, and indeed still are, widely used – Kim (2006a) reports that the tests have been translated into 35 different languages – and are easily administered. As a pencil and paper test, it takes 30 minutes to complete and have been taken by over 55000 children in North America alone (ibid). Furthermore, their advantage is that they can be adapted across age groups – criteria regarding fluency, flexibility, complexity, and the ability to evaluate can all be adjusted to age-related norms.

The TTCT are probably the most influential creativity tests but others are also in use as indicated in section A, notably the Wallach-Kogan tests (1965) focusing on fluency, flexibility, uniqueness and unusualness which are used in Hong Kong and elsewhere. Other commonly used tests look at specific aspects of creativity such as the Urban and Jellen (1996) tests for creative thinking through drawing production. A further widely used test is EPOC, developed by Lubart et al. (2011). This measures ‘Creative Abilities of Children’ in two areas (verbal and graphical, divergent and convergent thinking). EPOC is translated into Arabic, Turkish, German and English. Other translations are being investigated following the demands of researchers (Dutch, Greek, Russian, Portuguese, Italian).

Whichever their source however it could be argued that psychometric tests of creativity are inadequate in an educational setting. For, as a single one-off test, the results are heavily influenced by affective factors, such as environment and emotional state. The verbal test relies on semantic capability and cultural reference points. Furthermore, in focusing purely on assessing the product or outcome of students’ thinking, these tests are largely outdated as creativity is increasingly seen to apply not only to the person, but also to the product of creative activity and to the process of creativity. Equally the tests do not evaluate collaborative or collective creativity or indeed the relationships between individuals that nurture creativity.
Additionally, the psychometric assessment of creativity interprets creativity as divorced from cultural context, gender, race, community status and being a speaker of English as a second language. This is questioned in the USA by Kim (2006a, 2006b). Kim’s scepticism reflects the perspective many researchers would adopt, in the divorcing of the act of assessment from its context. Csikszentmihalyi (1996), for example, proposes a model of creativity that includes the domain, the person and the field. Creativity, according to this model, cannot occur in a vacuum; it is specific to particular domains and is affected, influenced and ultimately judged by the surrounding cultural context (the field). This has led to a second approach to the assessment of creativity, described as ‘componential testing’.

A psychometric approach to the assessment of creativity, then, sees creativity as generalized, objectifiable and measurable, adopts a focus on product rather than process, sites the locus of judgement outside of the creator, is focused on the individual’s performance and embraces the use of decontextualized standardized tests enabling judgements and comparisons to be made across time and across populations but raising questions about the inherent validity despite claims made by test developers. It tends to seek to offer a summative assessment in other words summing-up performance at a point in time. By so doing it can be used to compare children over time or to compare cohorts of children; in this way a summative use of a psychometric assessment test can also, like any other summative assessment, be used to report to parents, or for accountability or monitoring.

However, in the context of a shifting world in which team work, effective collaboration, a capacity to engage in self-evaluation, and to self-generate, are increasingly in demand, researchers, practitioners and policy makers are beginning to argue for more dynamic and situated approaches (e.g. Strom and Strom, 2011).

C1.2 Componential assessment

With a shift in perspective in the field toward a focus on the complexity of creativity (Feldusen and Ban, 1995) in encompassing the complexity of the cognitive activity, involving interlinked processes of decision making, metacognition and critical thinking in a wider personal and social context as well as involving both the product and processes of creativity, there has also emerged a new frame for the assessment of creativity - the componential approach. This term denotes the recognition of multiple ‘components’ or elements, in creativity and attempts to assess creativity more holistically, and in-context, encompassing a focus on either process or product, or, more usually, both. The work of Amabile (1983, 1990, 1996) has been influential in developing the componential approach. In assessing creativity using multiple components, Amabile has developed the Consensual Assessment Technique (CAT), which involves shared expertise around criteria derived by consensus, by judges of creativity.
This field of judges may include the producer – in the case of schools, the children themselves. Judges ultimately grade creative processes and products on a five-point scale from very uncreative to very creative.

There are many versions of Amabile’s CAT, some formally identified as such and others reflecting aspects of it, although some, for example the Reggio Emilia pre-schools in Northern Italy (Rinaldi, 2006) use their own version of a componential approach involving artists, teachers, children and to a degree parents, in the interpretation of documentation which evidences each child’s creative engagement and development. Other approaches to componential assessment have been developed at an informal though regional level for example in England the regional initiative, 5x5x5=creativity (Bancroft et al., 2008) which began in early years sites in the South West of England, emphasises the reach and potency of close written and photographic documentation of children’s learning undertaken by adults (teachers, parents, artists and others) in revealing complexities and depth of children’s creative engagement.

Large scale efforts are under way in the USA (CCSSO, 2011) to find ways to enable students, teachers and others to evaluate creativity with reference to originality and impact, and to build an international database of creative products from across the school curriculum along with some context and process data. A further national effort is under way in England (Spencer et al., 2012) to develop a dispositional approach to assessing creativity in context. Both are in development; their outcomes may prove salient for CLS in time.

Componential approaches involve the assessment of the process as well as the product. By noting the processes involved and their importance in creativity, there is an implicit corollary that these processes can be identified and, perhaps, fostered in individuals in an attempt to increase creativity. These componential approaches to assessment have important educational implications regarding the teaching of creativity in schools; and where creativity is seen to contribute to personalisation, it is difficult to imagine a rationale for taking anything other than a componential approach.

Indeed in practice, the componential approach has tended to be developed in European contexts whereas North American and far Eastern contexts are more likely to use a psychometric approach, although in the North American early years classroom there remains a concern for the learner and their trajectory (e.g. Cox Suarez, 2006; Donovan and Sutter, 2004; Paley, 2001). The focus on componential assessment in the classroom also reflects the growing concern to capture learning for formative purposes (Project Zero and Reggio Children, 2001).

As can be seen, this approach actively acknowledges the central role that the context in which creativity occurs has on both activity and outcomes and therefore seeks to incorporate this in its ‘measurements’ of creativity. A componential approach to the assessment of creativity, sees creativity as contextualised, rather than general,
and whilst it may be evaluated it cannot be measured in quite the same way as the psychometric approach would enable. Like the psychometric approach it adopts a focus on the product but can also be used to evaluate the process. It can be adapted for use with both individuals and pairs or groups. It sites the **locus of judgement with the field of judges which may include the creator/s.** It highlights the vital role of context and does not seek to decontextualize the assessment, as a result it may offer insight into change over time for individuals or groups. Assessments emerging from **componential approaches tend to be used formatively,** in other words to directly inform learning and teaching, and because of this those involved in the learning and teaching process i.e. pupils and teachers, are often involved in discussion of the assessment process and outcomes.

As can be seen these approaches are more qualitative in their approach than the psychometric tests and in recognising multiple forms of creativity (Han and Marvin, 2002, Besançon, Guignard and Lubart, 2006) offer the opportunity for negotiating values and judgements as well as feeding into next learning. The discursive and negotiative style of the componential approach means that culture, emotional climate and so on can be considered since we know these play an important role in the process of creativity (Davis, 2009) as do cultural issues as discussed in section A.

### C1.3 Other approaches to assessing creativity

In addition to psychometric and componential approaches, there are a number of other methods of measuring creativity. Many other assessments continue down similar psychometric routes to those outlined above and examine particular characteristics of personality supposed present in creative individuals, such as risk taking, independence, or humour (e.g. Martin, 2007) or look at features of creative environments such as in the workplace (e.g. Mathisen and Einarsen, 2004) and, as with the tests described above, aim to produce a creativity ‘score’ or ‘rating’. While it is important to acknowledge the existence of these various approaches, they are less appropriate for discussion in the early years context. Additionally, researchers such as Simonton (e.g. 1998) have looked at assessing notions of ‘high c creativity’ and the evaluation of creativity is based on the impact that ideas or products have had over a longer period of time. Though not aiming to produce a creativity rating per se, these tests does not appear appropriate for early years discussion as they focus on high c creativity.

Whilst as indicated above, North American and far Eastern contexts are more likely to use a psychometric approach with older learners, it is the **context-sensitive, child-centred, componential approaches that are most commonly in use in the early years,** particularly in Europe and in **parts** of North America, influenced by the approach to close observation and documentation of children’s learning developed in the Reggio Emilia pre-schools in Northern Italy and by practices evolved by
others in dialogue with these approaches (Bancroft et al., 2008, Krechevsky and Stork, 2000, Krechevsky et al., 2002).
D. Nature of research approaches to creativity in early years

As can be seen from the earlier sections of this literature review, the field of creativity and early years educational research is influenced by a number of key philosophical ideas. Empirical research undertaken in this field spans both positivist and interpretivist paradigms and therefore both quantitative (in which control groups are used, for example Peters, 1998, in New Zealand and Kamberelis, 1999 in the USA), and qualitative methodologies (for example, Trotman, and Jeffrey and Troman in England, and Paley and also Sawyer, in USA). Additionally, there are studies undertaken using mixed methods, particularly those interested in teachers’ attitudes (Harkness and , 2007; Smith, 1996; Westby and Dawson, 1995). Interestingly however, little research in the field of creativity in the early years appears to be undertaken in the critical paradigm, which may reflect both the age range (up to the age of eight) and perhaps also cultural beliefs around the world in relation to the education of the youngest children.

The different paradigms reflect contrasting perspectives on the underpinning ontology and epistemology ranging from a view of knowledge as ‘objectively true or false’ (which underpins the positivist paradigm) to a view of knowledge as ‘relative to the thinker’ (which underpins the interpretivist paradigm). Research undertaken in the United States and Far East tends to be undertaken more in the positivist paradigm although some very influential work (e.g. by Sawyer, Gardner, Paley, Egan and others) has been undertaken using the interpretivist paradigm in North America. In Europe there is more of a mixed picture with interpretive research being favoured by many. Educational research highlighting creativity in the early years encompasses a number of foci through which researchers study a wide variety of aspects of children’s learning and development. These might be summarised as four main themes: ‘questioning’, ‘play’, ‘children’s visual representations’ and ‘text making’.

D1. Questioning

Questioning has long been associated with creativity across all age groups, both in quantitative research in the form of divergent thinking tasks, such as the TTCTs described in Section C, and in qualitative studies. Looking at the Possibility Thinking work described above in Section B, central to this is posing the question ‘What if?’ . Chappell et al., (2008) discuss their empirical work examining children’s question posing and responding in the early years. It is this questioning in divergent tasks, or what they describe as ‘possibility broad’, they suggest, that drives Possibility Thinking and thus at the centre of creativity. These divergent or ‘possibility broad’ tasks may also provide opportunities for play in the early years (Lloyd and Howe, 2003).
D2. Play

Much of educational research literature exploring creativity in the early years focuses on play. Play is core to the aims of many early years curricula worldwide, and thus the research interest in it is perhaps unsurprising. While play can often have a varied and somewhat broad meaning, in the creativity literature there appears to be an intimate link between play and learning in the early years. Here, play is seen as the driving force behind learning and as creativity researchers appear to position creativity as an integral part of play, creativity is interpreted as an integral part of learning in the early years. For such a broad concept, unsurprisingly there have been a variety of different ways in which research on play and creativity has been approached in the early years. Work by Howard-Jones et al. (2002) and Garaigordobil and Berrueco (2011) have looked at the effect of play on creativity in the classroom, using quantitative methods of pre- and post-assessments, with both studies suggesting that sustained periods of regular play in early years settings increase creative thinking in young children. From an interpretive perspective, many researchers argue that play is the context for creativity in the early years (for example, Bancroft et al., 2008, Craft et al., 2012). In the early years, play and therefore research which foregrounds it, may not necessarily be confined to the classroom, as seen in the examples of Reggio Emilia schools and in the current trend for ‘Forest Schools’ in the UK. Outdoor play is widely researched, for example Canning (2010) looking at children’s imagination and creativity in outdoor den making as a means of play and Storli and Hagen (2010) examining the relationship between outdoor environments and children’s creativity and play.

D3. Children’s visual representations

The conception that mark-making is an innately creative dimension of learning pervades perspectives on education, much as the notion that mathematics and science are inherently ‘uncreative’ (Kaufman and Baer, 2004). The notion of children’s visual representations in education as enabling expression, or evidencing of young children’s creativity has been explored extensively. From a more quantitative perspective, there are a number of ways in which children’s drawings can be ‘tested’ or assessed such as, for example, the ‘draw a man’ test developed in the early 1940s and still used in research today (e.g. Uszynska, 1998) and ‘gestalt holistic assessment’ developed by Brewer (1989) and subsequently developed by others (e.g. Nelson et al., 1998). The use of these quantitative assessments allows researchers to assess children’s drawings on age-related or creativity scales. Interestingly, children’s visual representations have not only been researched in relation to the artistic dimension of children’s creative development. Nelson et al. (1998) for example, explored children’s picture making using the gestalt holistic assessment technique for assessing drawings and examined the relationship between chronological age, children’s rated-drawing ability and their scientific knowledge. Using a qualitative approach, Wood and
Hall (2011) investigated children’s drawing as a means of looking at ‘intellectual play’ in young children and identifying underlying imaginative and cognitive processes. Stevenson and Duncum (1998) also looked at this ‘intellectual play’ through children’s use of collage by identifying the symbolism involved in collage-making and the skills involved.

D4. Children’s text making

‘Text making’ in the early years, such as writing reports, instructions or narratives, has also been used as a means of observing and developing creativity in children, much in the way that children’s visual representations have been used as an indicator or assessor. Indeed, the notion of ‘creative writing’ appears as a phrase in curricula around the world. Longitudinal and ethnographic studies of children’s writing (e.g. Chapman, 1995; Pahl, 2007) have looked at how creativity develops in children’s writing as they progress through the early years. Much of this area of research has focused on the particular areas or domains in which children write. This work has been particularly useful when looking at creativity in science in the early years. Wollman-Bonilla (2000) for example, showed how even very young children would change their writing styles to suit instructional, recount of events and fictional narratives, an act that might be considered as ‘creative’ by Pahl (2007), who has suggested that children’s ability to bring a number of different experiences into one coherent piece of text is an indicator of their creativity.

In relation to exploring creativity in science and mathematics in the early years it may be that the foci of questioning, play, visual representations and text-making provide rich analytic contexts.
E. Policy

E1. Europe in general
A literature review undertaken during the 2009 European Year of Creativity and Innovation (Ferrari et al., 2009) offered a rationale for creative learning and innovative teaching across the European Union as a core element in the development of the 21st century knowledge society contributing to economic prosperity and also individual and social wellbeing. It identified education as a vital contributor in this task, offering four reasons for the development of children’s creativity and innovation: firstly the extension of new media into children’s lives opens up new ways of learning both formally and informally. Secondly, they argue that immersion in such environments enables new kinds of thinking and this requires new ways of teaching. Thirdly, they argue for creativity as a form of knowledge-creation for all, enabling and enhancing lifelong skills and competences, and enabling young people to make a contribution in a dynamic and demanding world. Finally they argue that educators are capable of unlocking children’s creative potential. As a result the report focuses on the development of the concepts of creative learning and innovative teaching, suggesting that creative learning requires innovative teaching and identifying a series of enablers for creativity and innovation in schools. These include approaches to assessment, school culture or ethos, curriculum, pedagogy, use of technology and tools (the creative use of digital technology is later explored by Craft, 2011). Such enablers, they argue, are indicators of environments which could nourish creative learning and innovative teaching. Clearly then, Ferrari et al. are positioning creativity as part of the role of self-actualisation, as discussed above in section B.

Following the 2009 Year of Creativity and Innovation, Banaji et al., (2010) undertook a study of exemplary creative and innovative practices across Europe. The study drew on a range of data from across the 27 EU Member States involving educational stakeholders from different fields of education, namely: academia, teacher training institutions, inspectorate boards, curriculum development agencies, and the Ministries of Education through 80 interviews, three in each country. The report identifies a number of trends the most evident of which was the diversity of provision for creativity and innovation with pockets of excellence needing greater systemic intervention and support. The following needs were identified: tackling innovation holistically (i.e. curriculum with assessment for example), addressing the inhibiting impact of league tables and performative policies, paying attention to ensuring school curricula can be inspiring but flexible offering space and time for children and teachers to imagine beyond these in flowing ways. Further it was suggested that flattening hierarchies to enable much greater agency throughout schools would be desirable enabling creativity in both children and teachers. Use of space within schools, with particular attention to how to foster learner-centred education, was highlighted for attention. Additionally, methods of
assessment that did not rely solely on children’s memorization and recall were examined. Use of ICT could be far more pervasive and mobile and hand held digital media should be integrated into the learning lives of all in schools, using these to their potential and not as replacements for analogue learning tools. Creative and collaborative skills should be fostered through ICT. Overall a shift in culture and mind-set of teachers and other adults including parents in education was called for. Initial and continuing teacher education, discussed above, were both highlighted as vital elements in engaging teachers with creative practices and a focus on student creativity and innovation with greater attention to pedagogy. The report concluded that creativity and innovation was enabled by time and space out of scheduled timetabling, motivation of teachers, tutors and others, and through creativity seen as arising from everyday life. Creativity and innovation was stifled by overloaded curricula, lack of time for flow and systemic barriers such as summative assessment and league tables and thus ultimately this team recommended a need to rethink compulsory educational provision.

2011 saw creativity and innovation attracting support from the European Union being identified in the 2020 policy goals for Education and Training (EC 2010). The education and training policy goals, then, include the enhancing of creativity and innovation, including entrepreneurship, at all levels of education and training. In 2011, the new ‘Creative Europe’ programme was launched, to support enterprises and organisations that operate across borders, and the 2014-2020 Budget Plan includes a commitment to financially support greater numbers of young people studying abroad. In April, 2011, the European Commission launched a Green Paper strategy for unlocking the potential of cultural and creative industries recognizing the contribution that can be made by Art schools.

**E1.1 Statistical analysis of European curricula**

In 2008, Heilmann and Korte (2010) undertook a content analysis study of the curriculum for 37 countries and regions across Europe, searching for the terms ‘creativity’, ‘innovation’ and their related synonyms. Their aim was to establish the relative occurrence of these key words in each curriculum, compare across subjects, age groups and countries. Their study surmised the frequency of words in terms of hits (i.e. occurrences) per thousand words (i.e. a relative frequency for creativity of 1 would mean that creativity would appear once in every 1000 words of text.)

The average relative occurrence of all search terms together (‘creativity’, ‘innovation’ and synonyms) in primary schools was determined at 0.68, However, there is a huge variance between the different countries, e.g. the overall occurrence of all search terms ranges from 0.00 in the Netherlands to 1.92 in Estonia. In the partner countries, the leading value for primary curriculum was in Northern Ireland (1.72) and the lowest was Romania with 0.21. Thus even within the small number of countries in this project there is a huge difference in the relative frequency between the highest and the lowest.
Of most relevance for this study may be Heilmann and Korte’s breakdown of the prevalence to subject curricula. Dividing curricula into eight categories, (art, ICT, languages, mathematics, natural sciences, ‘other’, physical education, and social sciences) they identify the relative frequency of the key search terms. Perhaps unsurprisingly, natural sciences and mathematics are the third lowest and lowest overall, showing an overall relative frequency of the key terms of 0.29 and 0.18 respectively. This compares to a relative frequency of 1.21 in art curricula, and an overall average of 0.68 in all primary curricular documents.

However, as with any content analysis work, Heilmann and Korte’s study is only useful up to a point. As their case study for Northern Ireland shows (:39), while the overall occurrence for creativity, innovation and it synonyms is high in the primary curriculum – over double the European average – when looking more closely at particular subjects it is possible to see that this does not tell the whole story. In both mathematics and ‘the world around us’ (in which science education is situated in the Northern Ireland curriculum) the occurrence of creativity, innovation and its synonyms is in fact zero. Much of the comparison data between subjects is across age groups, so while Heilmann and Korte report that ‘creativity’ is used with a relative frequency of 1.07 in the Finnish mathematics curriculum, it is not clear which age group this might be.

The statistics provided then may only provide a guide for the overall picture, more a flavour of curricula rather than detailed insights. Indeed, unfortunately, while overall statistics are shown, no further subject-specific data was available for the countries involved in the project in the report and attempts to contact the authors for further information were not successful. Additionally, the study does not differentiate between the ways in which the key words are used. It is not possible in a study of this nature to identify, for example, the rhetorics in which creativity is used. Similarly, there is no consideration to whether the terms are aimed at children or teachers – indeed many curricula lack specific guidelines that may help teachers in fostering creativity in their classrooms. Furthermore, regardless whether the key words have positive or negative connotations in the classroom, they will have equal weighting in the study. Context, definitions and implications were not considered in this study.

It is important therefore to remember that the statistics should only be used as a guide to provide further illumination rather than for detailed insight. Table 4, adapted from the statistics provided in Heilmann and Korte, provides a summary of their findings for the partner countries in this project.
Table 4: Table showing relative frequency of key words in curricula from partner countries.

Conclusions that can reliably be drawn from the study are those regarding what is not stated, for if it is not present, there can be no confusion about interpretation and so on. As Heilmann and Korte acknowledge, the term innovation “is hardly used and does not play a major role in school curricula texts anywhere in Europe” (:22). Only in Malta and Northern Ireland does the word ‘innovation’ have a relative frequency of more than 0.1 in the primary curriculum and is not used at all in Belgium, Finland, France, Germany, Greece or Scotland. What impact this may have on this study is discussed below in section F.

E.2. The countries represented in the project
In this section, each of the countries involved in the project are looked at in more detail, examining the curricular documents with reference to science and mathematics. The findings of Heilmann and Korte, discussed above, are considered in reference to this discussion. A table appears at the start of each subsection which illustrates the findings of Heilmann and Korte. Importantly, this is data from primary education only, therefore many of the tables are incomplete where, for example, data was given on both primary and secondary curricula combined.
E.2.1 Belgium: Flanders and Wallonia

<table>
<thead>
<tr>
<th>Creativity</th>
<th>Innovation</th>
<th>Synonyms</th>
<th>All items</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overall</td>
<td>Maths</td>
<td>Science</td>
</tr>
<tr>
<td>EU ave.</td>
<td>0.43</td>
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<tr>
<td>Belgium</td>
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<tr>
<td>(Fla.)</td>
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</tr>
<tr>
<td>Belgium</td>
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</tr>
<tr>
<td>(Wal.)</td>
<td></td>
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<td></td>
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</tbody>
</table>

Table 5: Table adapted from Heilmann and Korte (2010) showing relative frequency of words for Belgium. Figures for mathematics and science in primary education shown where data available.

The ‘developmental aims’ of nursery education and the ‘final objectives’ of primary education can be found in the common core curriculum, which applies to all schools in the Flanders areas of Belgium (Ministerie van Vorming en onderwijs, 2010). This core curriculum encourages the development of a “continuous learning process” for pupils that reflects their changing and developing educational needs. “Active learning”, where final objectives and developmental aims provide children with the opportunity to seek solutions, acquire experiences and gain insight within ‘true to life’ contexts is a key part of the primary curriculum.

The structure of the curriculum is similar to that of Te Whariki, discussed in section B, whereby areas of learning are interwoven with cross curricular themes. In this case there are only five areas of learning (physical education, art education, language (Dutch and French), World studies, mathematics) and three cross-curricular themes (learning to learn, social skills and ICT). While not reported in the Heilmann and Korte study, the word ‘creativity’ can be found in the objectives belonging to the area of art education rather than mathematics or science (under ‘world studies’). Problem solving skills are mentioned in the cross-curricular theme ‘Learning to learn’.

In the Flanders Eurydice report (FMET, 2010) it is possible to find information about the whole educational system in Flanders, including the general objectives, teaching methods and materials and approaches to pupil assessment in elementary education (FMET, 2010: 149-74). The report highlights how there are no official guidelines regarding teaching methods and teaching aids (such as school books), however the curriculum encourages children to be “given the chance to experiment, discover, discuss... either independently or with the help of other children/adults”. As in many countries, activities in nursery education are often centred on a specific theme of point of interest. In several schools
the themes are topics the infants bring up themselves. Working in specific classroom areas as an organizational structure is found in most nursery schools.

In the National Report 2009 (Ministry of Education and Training Flemish Community, 2009) learning outcomes outline what the pupils minimally have to know and be able to do, but they do not define how these objectives are to be reached. The schools are totally free in this respect. There is room for diversity and difference in approach. September 2010 saw the framework being implemented. The framework focuses on personal development in relation to others and on the ability to participate in a multicultural, democratic society. This educational focus is first of all elaborated in a set of context free, rather broad objectives that can be applied to all subjects and contexts. For instance: critical thinking, creativity, empathy etc.

“Flanders in action” (FG, 2006) is a socio-economic action program which started in 2004 and will run until 2020. The program describes socio-economic six challenges which should be addressed in order for Flanders to achieve the “ambition to belong to the leading group in Europe” (:4). These challenges include “creativity, the culture of innovation and entrepreneurial spirit” (:5). Thus we can see that the ‘Flanders in action’ document interprets creativity clearly as Banaji and Burn’s rhetoric of creativity as the economic imperative.

As Table 5 above shows, the education systems in the Flanders area and Wallonia area of Belgium differ – a paper from the Education, Audiovisual and Culture Executive Agency (2010) outlines the specific aims of Early Years (Pre-Primary and Primary) education for Wallonia are to develop children’s awareness of their individual potential and encourage self-expression through creative activities; to develop socialisation; to develop the learning of cognitive, social, affective, and psychomotor skills; develop open-mindedness, curiosity, a taste and desire for learning, the ability to perceive a problem, define its elements, find a solution to it, and structure knowledge; to identify children's difficulties and handicaps and address these through remediation.

In nursery education it is recommended to carry out projects that are suited to children’s interests, which allows for voluntary action, acceptance, and participation in attaining the objectives. Pupils are divided into groups. These groups take part in various workshops organised by the teacher, who mainly takes care of one group, (e.g. painting, building game, library, mathematics, discovery, make-believe games: dolls, shops, etc.). Primary education is largely undifferentiated; all pupils in the same class are often faced with the same activities. Ministerial circular letters recommend group activities; learning situations that encourage behavioural patterns suited for decision-making on the sequence of tasks, negotiation on the nature of the work to be done, and interaction among pupils; a general, functional, participative, and differentiated teaching method.
E.2.2 Finland

<table>
<thead>
<tr>
<th>Creativity</th>
<th>Innovation</th>
<th>Synonyms</th>
<th>All items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>Maths</td>
<td>Science</td>
<td>Overall</td>
</tr>
<tr>
<td>EU ave.</td>
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<tr>
<td>Finland</td>
<td>0.59</td>
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<td>0.31</td>
</tr>
</tbody>
</table>

Table 6: Table adapted from Heilmann and Korte (2010) showing relative frequency of words for Finland. Figures for mathematics and science in primary education shown where data available.

The core curriculum of preschool education (NBE, 2000) is the only policy document about the goals and contents of education in this age group (6 year old children) and only implicitly highlights creativity in education. The core role of pre-school education shall be to promote children’s favourable growth, development and learning opportunities. It shall support and monitor physical, psychological, social, cognitive and emotional development and prevent any difficulties that may arise. Children’s world of experiences shall be enriched and children shall be assisted as they seek to find new areas of interest. Children will adopt basic skills, knowledge and capabilities from different areas of learning in accordance with their age and abilities. Learning through play is essential.

Heilmann and Korte showed that Finland is one of a number of countries in Europe, as well as for example Sweden, Poland and the Netherlands, not to use the word creativity at all in the context of the natural sciences curriculum, either at primary or secondary level.

E.2.3 France

<table>
<thead>
<tr>
<th>Creativity</th>
<th>Innovation</th>
<th>Synonyms</th>
<th>All items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>Maths</td>
<td>Science</td>
<td>Overall</td>
</tr>
<tr>
<td>EU ave.</td>
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</tr>
<tr>
<td>France</td>
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</tr>
</tbody>
</table>

Table 7: Table adapted from Heilmann and Korte (2010) showing relative frequency of words for France. Figures for mathematics and science in primary education shown where data available.
A key objective of National Education in France is to encourage experimentation (MEN, 2006). Indeed, it states that encouraging the teaching staff to exercise their creativity and responsibility and offering new approaches and organizations, contributes to the success of all students.

One of the key initiatives in France that is of particular interest for this study is “La main à la pâte” (“Hands on”). It was launched in 1996 with the aim of renovating the teaching of science and technology in primary schools by promoting education based on a process of scientific investigation. The aim was to renew and expand science teaching in school in France and subsequently contributed to achieving this aim in a large number of countries. The aim of “La main à la pâte” is for teachers to prompt scientific questioning by providing students with objects and phenomena from the world around them. This then leads to the formulation of hypotheses to be tested by experiment or verified by a literature search. Thus, students gradually take ownership of scientific concepts and operative techniques and strengthen their oral and written expression. The project recommends the implementation by teachers of a pedagogy of investigation involving exploration of the world, science education, experimentation and reasoning, language skills and argumentation, so that every child deepen his understanding of objects and phenomena surrounding and develops curiosity, creativity and critical thinking.

**E.2.4 Germany**

<table>
<thead>
<tr>
<th></th>
<th>Creativity</th>
<th>Innovation</th>
<th>Synonyms</th>
<th>All items</th>
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<td>Maths</td>
<td>Science</td>
<td>Overall</td>
</tr>
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</tr>
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<td><strong>Ger.</strong>*</td>
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</tbody>
</table>

*Table 8: Table adapted from Heilmann and Korte (2010) showing relative frequency of words for Germany. Figures for mathematics and science in primary education shown where data available.

* Heilmann and Korte examined three different German regions; Lower Saxony, Bavaria and Saxony. The figures given above are averages for the three areas.

According to the KMK document (2004), seen as a guideline for all the German federal states, young children’s (up to 6 years) interest should be met in the lessons'/projects' contents to foster holistic learning. Therefore, children should be free to experiment and explore self-dependently. The document suggests that kindergarten education...
provides a useful environment in which to advance children’s creativity, as learning takes place in a relaxed environment and explorative and critical thinking is cultivated. It appears then that the KMK document takes a more ‘self-actualisation’ approach to creativity. Creativity is also mentioned in the children’s ecological education. KMK points out that especially the outdoor education has a lot of potential for creative and learner-orientated teaching methods. Although creativity is mentioned as one of the general pedagogic principles, it is only mentioned once in a sub-theme of scientific and mathematical education. As with many curricula, Creativity seems to have a higher significance in artistic and musical education.

Looking at the federal state of Hesse as an example, the curricular literature there states that creativity should be fostered in early childhood education through inquiry-based learning and a relaxed learning atmosphere (Fthenakis et al., 2011). Children (0-10 years) are supposed to actively engage in the tasks at hand, finding their own ways to solve problems. Through this, a positive and creative attitude towards task-solving can be established. Moreover, in children's life praxis, creativity seems to be a means to actively transform and participate in one’s environment. Children should learn how to communicate in a creative and self-determined way and are supposed to integrate communication into their problem-solving patterns/behaviour. Despite this however, although creative thinking is mentioned in the text as one of the main principles in children’s cognitive development in general, it is further only mentioned in connection with children’s arts and sports education, and not in the children's science learning.

### E.2.5 Greece

<table>
<thead>
<tr>
<th>Creativity</th>
<th>Innovation</th>
<th>Synonyms</th>
<th>All items</th>
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<td><strong>Maths</strong></td>
<td><strong>Science</strong></td>
<td><strong>Overall</strong></td>
</tr>
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<td><strong>EU ave.</strong></td>
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<td><strong>Greece</strong></td>
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</tr>
</tbody>
</table>

*Table 9: Table adapted from Heilmann and Korte (2010) showing relative frequency of words for Greece. Figures for mathematics and science in primary education shown where data available.*

In the first curriculum for pre-primary education in Greece (GPI, 2003), creativity plays a leading part in the current curriculum for pre-primary education and is defined as one of the main objectives. Pre-primary teachers are expected to design activities that are flexible and lead to investigation in order to foster and cultivate creativity and creative
thinking. From all the areas of development of activities (Language, mathematics, study of the natural environment, expression, and new technologies) the area in which the children are mostly called to express their creativity is the area of art, dramatization, music and physical education. No definition of creativity or specific instruction on how to foster creativity is provided for teachers, thus it appears that teachers have to plan and carry out activities to foster creativity with no support or guidance.

For primary education, creativity is outlined by the Cross-Thematic Curriculum Framework (GPI, 2003) as a key target or outcome. A new approach based on interdisciplinarity and creative learning is introduced through what is called 'the Flexible Zone’. The ‘flexible zone’ is part of the school programme devoted to cross-thematic projects and collaborative learning with the aim of enhancing exploratory learning as well as creative and critical thinking. The term ‘creativity’ and its various cognates are used constantly in this framework, but no explicit working definition of creativity or a theoretical framework that may aid teachers in fostering creativity and creative thinking is apparent. Indeed, creativity is referred either as an intended outcome (e.g. to develop critical and creative thinking) or as a characteristic of certain learning activities (e.g. to utilize a number of different teaching techniques either closed-ended… or open-ended and creative). Here we can see evidence of the instrumentalist nature of creativity in the Greek curriculum, where creativity is an activity or outcome, rather than, in comparison the means of self-actualisation described above in section B. Examining specific curricula provides further evidence. For example, the curriculum for “Studying the environment” (GPI, 2010a), creativity is brought up in numerous occasions as a learning outcome (e.g. to creatively express habits and customs) but, similarly to the current curriculum there is no working definition of the term and no specific instruction is given to the teachers in order for them to foster creativity. In the mathematics curriculum for primary education (GPI, 2010b), creative thinking is defined as one of the three components of “mathematic thinking” along with reflective thinking and critical thinking. However, creativity is not mentioned again in any of the proposed activities presented and is only mentioned as one of the criteria for assessment of certain activities, that project work has to be creative.

A new curriculum for pre-primary education which is being piloted during the 2011-12 school year (GPI, 2010c) will be in effect from the following year in all schools. Creativity, along with critical thinking, is defined as one of the four central skills promoted in the curriculum. Creative thinking is defined as “the way of thinking that generates new approaches, original ideas and perspectives, alternative ways of understanding and comprehending concepts.” Problem solving is referred as the main activity which promotes creative thinking. For science in pre-primary education, creativity is presented as an outcome of meaningful teaching activities but without specific mention of which of the example
activities mentioned in the document foster creativity. Creativity is not mentioned in the mathematics section of the new curriculum.

E.2.6 Malta

<table>
<thead>
<tr>
<th></th>
<th>Creativity</th>
<th>Innovation</th>
<th>Synonyms</th>
<th>All items</th>
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<td></td>
<td>Overall</td>
<td>Maths</td>
<td>Science</td>
<td>Overall</td>
</tr>
<tr>
<td>EU ave.</td>
<td>0.43</td>
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</tr>
<tr>
<td>Malta</td>
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</tr>
</tbody>
</table>

Table 10: Table adapted from Heilmann and Korte (2010) showing relative frequency of words for Malta. Figures for mathematics and science in primary education shown where data available.

The National Minimum Curriculum (MEEF, 2006) states what each and every child is entitled to as part of his/her education and which binds every school with the legal obligation to fulfil. It is a broad document and talks about education in a holistic way. The section tackling early years education lists as one of the aims of early years as that of Development of a Sense of Aesthetics and Creativity. It is argued that the learning environment at Kindergarten level should provide opportunities for children to engage in symbolic representation, imaginative play, art and crafts, drama, movement and music. This process of aesthetic and creative sensibility should also include the appreciation of one’s own creative work and that of others. There is also reference to creativity with respect to the first years of primary education which starts at the age of 5 years. There is written that the four years that follow early childhood education marks the beginning of a progression, at a faster rate, towards greater formality in education. But this does not imply that one eschews creativity, spontaneity, exploration, play, experimentation, incidental learning, the integration of knowledge and flexibility in the planning and methodology of learning. The period from Year 3 till Year 6, constituting the second phase of primary education, involves a process in which children are encouraged to reflect, think, engage in creative thinking, ask questions, criticise, solve problems, observe, view information critically, carry. It is also possible to find reference to creativity across the curriculum as an area for action research for teachers to tackle in recognition of its importance.

A new proposed National Curriculum Framework (MEEF, 2011) will replace the National Minimum Curriculum once finalised. The publication contains a summary of what is being proposed as three other documents provided further details on the different aspects being tacked. There is mentioned that the National Curriculum proposes five cross-curricular
themes, one of which is creativity and innovation. These cross-curricular themes are considered essential components for a holistic education and they are meant to be embedded in the different learning areas and to provide connecting strands across the learning areas.

In summarising the early years education, which is further developed in document 3, it encourages programmes of activities which move away from specific subject or content teaching in favour of pedagogies which enhance curricular links and thus facilitate learning processes that respond to children’s interests and prior knowledge, respect young learners’ cognitive maturity and preferred learning patterns, stimulate curiosity, instil an interest for learning, promote exploration, discovery and creativity, and foster environments which promote communication and interactive styles of learning. Through programmes which seek children’s active involvement and experiential learning, children are expected to acquire social, communicative and intellectual competences in an environment which fosters personal well-being and positive learning dispositions.

This document (MEEF, 2006) involves a review of European and national policies on early childhood education and focuses mainly on the provision of child-care at pre preschool stage and the quality of service provided at this level, but also at kindergarten level (3-4 years). It also looks at transition to compulsory schooling. The main focus of the document however is on standards of child-care centres and qualifications of staff. There is reference to early childhood education curriculum at level 3-4 years and that there is no official curriculum at this point in time. It is interesting to note that the only reference to creativity was that of a course title relating to in-service training which had been provided as part of in-service training. The document focuses more on the qualifications of the trainers and insists on the need for professionally trained people in the early years than on the type of education to be provided. The reason for this may be that this requirement is fulfilled by the National Minimum Curriculum.
E.2.7 Portugal

<table>
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<th>Innovation</th>
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<th>All items</th>
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<tbody>
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<td></td>
<td>Overall</td>
<td>Maths</td>
<td>Science</td>
<td>Overall</td>
</tr>
<tr>
<td>EU ave.</td>
<td>0.43</td>
<td>0.02</td>
<td>0.23</td>
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</tr>
<tr>
<td>Portugal*</td>
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<td>0.04</td>
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</tr>
</tbody>
</table>

Table 11: Table adapted from Heilmann and Korte (2010) showing relative frequency of words for Portugal. Figures for mathematics and science in primary education shown where data available.

* Portugal is in the process of developing a new curriculum.

The Framework Law for Pre-School Education (ME, 1997a) outlines the objectives of Pre-school education (3-6 years of age). Although there is no explicit reference to creativity, there are some that may indicate, implicitly, that the child’s creative action associated with them such as: “d) To encourage the overall development of each child, respecting their individual characteristics, instilling behaviours that promote meaningful learning and diversified” and “f) to awaken curiosity and critical thinking”.

The previous government set pre-school system as a priority but no new legislation was issued. The ideas of the new ministry are not yet clear.

The law of the Education system (ME, 2005) states, in article 2, one of the general principles of education is to promote “the development of the democratic spirit pluralistic and respectful of others and their ideas, open to dialogue and free exchange of opinions, forming citizens able to critically judge the creative and social environment in which they live and engage in its progressive transformation.” It also states in article 5, that one of the objectives of preschool education is to “develop the skills of expression and communication of the child, as well as the imagination and encourage creative play activities.” In turn, for Basic Education, article 7 states that one of its aims is to “provide training common to all the Portuguese that guarantees the discovery and development of their interests and skills, reasoning ability, memory and critical thinking, [and] creativity.”

The final report of the Committee on Education System Reform (CRSE, 1988) appears to be the only document that discusses the theme of creativity explicitly. It refers to ‘education for change’ as one of the guiding principles, and as such interprets creativity to mean “encourage[ing] and develop[ing] rigorous thinking, [and] critical and creative, flexible minds…” (:25). The report identified the role of education as preparing people for further potential changes in society to occur, and therefore proposed “the need to promote and strengthen the
forces of innovation and creativity,” because “to a more open and dynamic we need a school more creative, innovative and active” (:45). Currently, there are potential changes occurring with the new government as ministers have more than once referred to the need of more “creativity” in schools. However at the present time it is not clear what is meant by this or the potential implications.

The promotion of creativity is not only stated in the Law of the Portuguese education system in terms of their intentions and objectives, but also in the current National Curriculum for Basic Education (ME, 2001) that defines the core competencies of the exit pupil of each of the cycles of basic education. Competence, in this official document, refers to the process of activating ‘resources’ (knowledge, skills, strategies) in various situations, including problem situations (:9). Regarding creativity, there is, in this official document, that one of the skills that students should develop during basic education is “undertake an independent, responsible and creative” (:15). Thus creativity here is instrumental in its nature. The document outlines a number of ways in which creativity may be fostered in the classroom. Many of these revolve around basing activities on what it describes as the “initiative of the student” (:24) and facilitating autonomy. Indeed, autonomy and expression of creativity appear to be synonymous in this document.

The specific guidelines for the development of mathematical competence that mathematics is referred to as school discipline, sharing many features with other curriculum subjects and, when developed in tandem contributes greatly to the development of skills lawful general recommended for Basic Education. Unlike many other countries, creativity is mentioned in the mathematics curriculum. It is stated in the curriculum that an “appropriate mix of work in mathematics with other areas of the curriculum should result in growth of students both from the point of view of autonomy, responsibility and creativity, as in the perspective of cooperation and solidarity” (:59).

However, in neither the general curriculum guidelines for pre-school education (ME-OCEP, 1997b) (3-6 years) or in the current document that defines the learning goals for pre-school children does there appear to be any reference to the term creativity. This is despite the Law of the Portuguese education system, in Article 5, taking the promotion of creativity in children as one of the objectives for this level of education.

In Portugal there seems to be a trend to give more attention to pre-school education but no new rules or regulations were set so far. No special reference is made to creativity but recent governmental determinations point to an increased attention to be paid to maths in all school levels, science and geography in primary and physics in late basic, the 3rd cycle (ages above 9) and secondary levels.
Table 12: Table adapted from Heilmann and Korte (2010) showing relative frequency of words for Romania. Figures for mathematics and science in primary education shown where data available.

The law of National Education (MERYS, 2011) provides the framework for the exercise, under the Romanian state authority, of the fundamental right to lifelong education. The law governs the structure, functions, organization and functioning of the national education system, financed by the state, or private and confessional. The law promotes a values-oriented education, where creativity, cognitive abilities, actional volitional capacities and capabilities, fundamental knowledge, skills and abilities of direct utility within the profession and society are of importance. Basic skills in mathematics, science and technology are outlined in the National Curriculum as one of eight key skill areas or competences that children are to develop over both primary and secondary education.

According to the Curriculum for early childhood education (MERYS, 2008) (0-6/7 years), general objectives of the early education are the free, full and harmonious development of child personality, according to his or her own pace and needs, supporting the autonomous and creative formation, the development of the capacity to interact with other children, adults and the environment to acquire knowledge, skills, attitudes and new conducts, the encouragement of exploration, exercises, tests and experiments, as autonomous learning experiences, the discovery by each child of his or her own identity, autonomy and the development of a positive self-image, the child’s support in the acquisition of knowledge, abilities, skills and attitudes necessary for its entry into school and throughout life.

Learning activities are carried out either with the whole group or in small groups as integrated activities (with interdisciplinary knowledge) across the five areas of the curriculum; language and communication, science (which includes mathematics), arts, physical education and social education. Across these areas, there are also a number of ‘developmental areas’, the fifth of which is described as “capacities and attitudes in learning with characteristics: curiosity and interest, initiative, persistence in work, creativity.” It is here, in the developmental areas’ that the main
mentions of creativity occur in the curriculum, rather than in any subject-specific context. There is also discussion of creativity when discussing the physical space in which children are taught. Here it is discussed in terms of thinking and choice, which might be interpreted as similar to ‘critical thinking’ interpretations of creativity.

**E.2.9 United Kingdom – England**

<table>
<thead>
<tr>
<th>Creativity</th>
<th>Innovation</th>
<th>Synonyms</th>
<th>All items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>Maths</td>
<td>Science</td>
<td>Overall</td>
</tr>
<tr>
<td>EU ave.</td>
<td>0.43</td>
<td>0.02</td>
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</tr>
<tr>
<td>England*</td>
<td>1.00</td>
<td>0.03</td>
<td>0.1</td>
</tr>
</tbody>
</table>

* *England is in the process of developing a new curriculum, likely to be implemented in 2013*

The aims of the current National Curriculum for primary education indicate that the curriculum should ‘enable pupils to think creatively and critically, to solve problems’ and ‘give them the opportunity to become creative, innovative, enterprising’. In the introductory sections of the curriculum document reference is made to opportunities for promoting thinking skills across the curriculum. Thinking skills related to ‘creative thinking’ (enable pupils to generate and extend ideas, to suggest hypotheses, to apply imagination, to look for alternative, innovative outcomes) are listed alongside those associated with information processing, reasoning, enquiry and evaluation. It is suggested that these skills are embedded in the curriculum and that using thinking skills can help children to learn how to learn. However no specific indications are given of connections with the programmes of study or assessment criteria associated with the subject content of the National Curriculum. Links between creative thinking and the other thinking skills are not explored. Furthermore references to creativity in the subject requirements are limited. This separation between aims, the promotion of creative thinking and the main subject content in the document obscures the way these can be integrated in teaching.

In the current Early years and foundation stage (EYFS) documentation (e.g. DCSF, 2009), one of the ‘commitments’ of the EYFS, along with play and exploration and active learning, is ‘creativity and critical thinking’ which is to be applied across the curriculum. This is about child led processes, especially making connections. However one of the limitations
of the EYFS documentation is that the arts-related part of the curriculum is called ‘creative development’. This implies therefore that creativity is solely related to the art and thus have an impact on practitioners’ understanding of creativity. While creativity is included in the appendices of the proposed EY curriculum, it is less obvious in the main body of the report.

**E.2.10 United Kingdom – Northern Ireland**

<table>
<thead>
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<th>Innovation</th>
<th>Synonyms</th>
<th>All items</th>
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<td>Overall</td>
<td>Maths</td>
<td>Science</td>
<td>Overall</td>
</tr>
<tr>
<td>EU ave.</td>
<td>0.43</td>
<td>0.02</td>
<td>0.23</td>
</tr>
<tr>
<td>N. Ireland</td>
<td>1.00</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

*Table 14: Table adapted from Heilmann and Korte (2010) showing relative frequency of words for Northern Ireland. Figures for mathematics and science in primary education shown where data available.*

*All instances of the word ‘innovation’ in the primary curriculum occur in the ‘physical education’ section of the curriculum (Heilmann and Korte, 2010: 39).*

**E.2.11 United Kingdom – Scotland**

<table>
<thead>
<tr>
<th>Creativity</th>
<th>Innovation</th>
<th>Synonyms</th>
<th>All items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>Maths</td>
<td>Science</td>
<td>Overall</td>
</tr>
<tr>
<td>EU ave.</td>
<td>0.43</td>
<td>0.02</td>
<td>0.23</td>
</tr>
<tr>
<td>Scotland</td>
<td>0.37</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

*Table 15: Table adapted from Heilmann and Korte (2010) showing relative frequency of words for Scotland. Figures for mathematics and science in primary education shown where data available.*

The Curriculum for Excellence in Scotland (Scottish Executive, 2004) was created in 2004 to try and address many issues in education. The aims of the document were to draw together overarching aims for children by putting forward this curriculum for 3-18 years and giving schools and teachers more flexibility. The curriculum has the aim of being bold and putting power back into teachers - to remove teaching for assessment
etc. It puts forward four key drivers: successful learners, confident individuals, responsible citizens and effective contributors.

As diagram above, drawn from page 16, *Curriculum for Excellence: Building the Curriculum 3*, (SE, 2007) the key drivers are encompassed within key skills for learning, life and work: Numeracy, Literacy and Health and Wellbeing.

Whilst noble on the surface, the curriculum has been criticized for providing limited detail on how to carry out the aims in everyday classroom practice. Moreover, as highlighted by Priestly and Humes (2010), by providing specific learning objectives that will ultimately be used for assessment, the curriculum is contradictory. Other related criticisms include the lack of meaning of the four main aims listed above; whether the adjectives could be swapped around with any significant change.

In 2007, the Scottish Executive published the *Curriculum for Excellence: building the curriculum 2* which sets out how the new curriculum works for the early years: “active learning in the early years”. Active learning is defined as “learning which engages and challenges children’s thinking using real-life and imaginary situations”. Accordingly, it is intended take advantage of:

- spontaneous play
- planned, purposeful play
- investigating and exploring
- events and life experiences
- focused learning and teaching

This document argues that teachers need to: build on prior learning, and make learning meaningful and enjoyable, but again it is limited in suggestions on how to achieve this, though it does show how progress can be monitored through outcomes. As Priestly and Humes (2010) indicate this leads to contradictions: an open discovery curriculum message followed by more directed objectives.
E2.12 United Kingdom – Wales

<table>
<thead>
<tr>
<th>Creativity</th>
<th>Innovation</th>
<th>Synonyms</th>
<th>All items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>Maths</td>
<td>Science</td>
<td>Overall</td>
</tr>
<tr>
<td>EU ave.</td>
<td>0.43</td>
<td>0.02</td>
<td>0.23</td>
</tr>
<tr>
<td>Wales</td>
<td>0.34</td>
<td>0.01</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Table 16: Table adapted from Heilmann and Korte (2010) showing relative frequency of words for Wales. Figures for mathematics and science in primary education shown where data available.

In the Framework for Children’s Learning for 3 to 7-year-olds in Wales (DCELLS, 2008), there are 7 areas of learning, including ‘mathematical development’, ‘knowledge and understanding of the world’ (which includes science) and ‘creative development’. The introduction to the framework emphasises that children should be given “opportunities to be creatively involved in their own learning” (DCELLS, 2008). Terms used include; ‘discovery’, ‘exciting’, ‘apply imagination’, ‘express themselves’, ‘natural curiosity’, ‘originality of children’s work’, and ‘stimulating environments’. Thinking is to be developed as a cross-curricular skill with the aim of children thinking creatively and critically. Mathematical development includes problem solving, exploring number, using flexible methods for mental calculation, exploring and creating simple patterns and relationships. Knowledge and understanding of the world includes enquiry, investigating the environment, increasing curiosity, experimentation, asking questions, expressing themselves with imagination, creativity and sensitivity. Creative development talks about "developing their imagination and creativity across the curriculum" (DCELLS, 2008) but the content area of creative development relates to art, craft and design, music and creative movement.
F. Emerging tensions, dilemmas and issues for CLS

F1. Emerging conceptual/contextual ground and any notable issues

The review has explored a range of ways of defining creativity as distinct from innovation (the latter denoting economic application), tracing the gradual focus of research on creativity as socially situated and influenced, as having an ethical component and as spanning paradigm-shifting ‘historical’ ‘big-c’ creativity and everyday, personal, ‘mini- or little-c’ creativity. In relation to learning, research reveals cognitive, conative and environmental factors at play. In the early years, attempts to model creativity focus more on process and outcome with some focus on personal qualities involved, with a recognition of the role played by creativity in enabling (and being in turn stimulated by) self-actualisation and with some interest in the psychodynamics of children’s creativity. Whilst psychometric approaches are also in vogue, particularly in relation to assessing creativity, these are more widely used in the East than in Europe and much work is situated in the interpretive paradigm seeking not to explain or predict but to characterise. Perspectives on early years creativity in the research literature thus mesh closely with child-centred philosophies which have influenced provision over the last two centuries and situate the child as creative in the sense of being a constructor of personal and shared meaning.

Although creativity in the early years is prioritised at pan-European level and to (differing) degrees in each of the national contexts associated with this research study, tension exists between approaches which are essentially ‘instrumentalist’ and those which emphasise ‘self-actualisation’ (and these in turn can be related to a series of ‘discourses’ of creativity in educational policy articulated by Banaji et al., 2010). The contrasting perspectives of ‘instrumentalist’ and ‘self-actualising’ can be applied to the research paradigms also such that the cognitive, psychometric and confluence paradigms could be seen as reflecting ‘instrumentalist’ approaches to researching creativity. On the other hand, humanistic and social personality paradigms might be seen as reflecting a ‘romantic self-actualisation’ approach. Some paradigms (pragmatic, mystical and psychodynamic and evolutionary) can be seen as reflecting both.

In relation to pedagogy, the importance of teachers’ underpinning attitudes and beliefs has been highlighted together with the distinction between teaching creatively and teaching for creativity. The multiple features of creative pedagogies, the role of relevance in learning and the balance and potential tensions between standing back and intervening together with critical reflection, ethos and relationships as well as the challenge of orchestrating creative teaching, were also highlighted.

Whilst creativity is firmly acknowledged within both research and policy as inherent in the experiences and characteristics of young children, ways
of evaluating children’s creativity reveal a tension between componential, context-sensitive, formative approaches that often involve the children themselves and psychometric testing which is context free, summative and involves no interpretation but nevertheless provide data that can be compared across time and across populations.

It was also noted during the review that the research approaches adopted in the investigation of young children’s creativity span the interpretivist and positivist paradigms although interpretivist accounts are more commonly used, resulting in the documenting and interpreting of lived experience.

F2. Issues and implications for CLS: creativity research gaps
The following issues emerge from this literature review for the research design of Creative Little Scientists.

F2.1 Cultural differences: how creativity perceived in education
Whilst research documents East/West differences, there is no work exploring possible differences / similarities across different European contexts.

F2.2 Assessing creativity in early years mathematics and science
There is no research documenting how teachers evaluate creativity in the early years classroom in mathematics and science; there would be scope for this project to explore creative elements within mathematics and science in the early years.

F2.3 Teacher role as play/dialogue partner
There is little research on dialogical pedagogical model in relation to creativity: teacher re-positioned as collaborator in application and production of knowledge and connections with creativity in maths and science classrooms.

F2.4 Classroom ethos and resourcing
There is little research on the physical, conative and cognitive dimensions of how resources and technologies (including digital ones) are appropriated so as to support creativity in maths and science.

F2.5 Teachers’ identities
It will be important to document how teachers see themselves as scientists and mathematicians and their degrees of assurance towards science and mathematics teaching and similarly toward creativity.

F2.6 Pedagogical style
Tensions were identified between exploratory play and explicit instruction (Bonawitz, et al., 2011); the latter curtails the former (and thus perhaps creativity); this apparent dichotomy (which may be similar to the tension between open vs. guided inquiry teaching approaches) deserves exploration in early years mathematics/science classrooms. Teasing out
the complexity that may be involved in for example teachers offering ‘scaffolding’ in children’s play. In addition, the key features of creative practice and their relationship to practice in science and mathematics represent important areas for future investigation.

F3. Issues and implications for CLS in respect of methodology
A number of issues arose during this review with respect to the CLS methodology.

F3.1 Which paradigms
We suggest cognitive – to the degree we are interested in developing models, together with humanistic – connoting an emphasis on children’s and early years practitioners’ self-actualisation, and confluence – a desire to recognise the complexity of systems.

F3.2 Which discourse
Drawing on Banaji et al. (2010), we suggest the discourses of play and creativity, and creative classroom as important to explore, situated in the context of meaning-making in the domains of science and mathematics education.

F3.3 Which epistemological framing
Drawing on the distinction made by Gibson (2005) and reflecting the wider context to research on early childhood creativity, we suggest self-actualisation though recognise possible tension with the wider EU policy perspective which might be described more as an instrumentalist one; such tensions will need teasing out during the project.

F3.4 Which methodology
With a tension between the possibilities offered by seeking lived experience or objective documentation, we suggest adopting an interpretive perspective, seeking to document lived experience, building on other early years studies in relation to creativity. In relation to whether this study should be phenomenological or critical, considering the purpose of CLS as set out in the Description of Work, we suggest phenomenological – CLS seeks to understand rather than transform.

F4. Emergent, relevant working definitions of key terms
The following terms will be used widely throughout this study and drawing on this literature review we propose here some working definitions.

**Creativity**: We propose CLS will focus on little c, or personal, or everyday, creativity, i.e. purposive imaginative activity generating outcomes that are original and valuable in relation to the learner.

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8 The terms within this definition in particular will be further clarified in relation to meaning of ‘imaginative’, ‘purposive’, ‘outcomes’, ‘originality’, ‘value’ and locus of judgement. These have all been explored in the context of literature on ‘little c’ and ‘mini-c’ creativity cited in this review.
Innovation: we propose CLS focuses on innovation as profitable use of creativity (i.e. not necessarily in an economic sense)

Possibility thinking: may be a valuable to extend research undertaken in early years on PT and pedagogy that fosters it. PT involves the generative shift from what is to what might be, through ‘what if?’ and ‘as if’ thinking and manifests individual, collaborative (shared) and communal (jointly ‘owned’) creativity

Componential assessment of creativity: we propose exploring how teachers evaluate creativity in context of science and maths, balancing process and product, how formative, how used by individuals as well as pairs and groups and how involves learners as well as teachers, with locus of judgement as belonging with the field of judges which may include the children.

F5. Possible research foci, research questions and approach

Building on the literature review and the issues highlighted above together with the purpose of the study, we propose the following research foci, questions and sub-questions.

F5.1 Possible research foci and questions:
- What does creativity in early years science and mathematics look like?
- How is it fostered?
- How do teachers perceive their role in doing so?

F5.2 Sub-questions running across all three research questions might be a focus on
- The role of imaginative storying (inc. emotional connection/meaning making)
- The role of exploration, questioning and argument
- Ethos (including resources, emotional context)
- Roles of adults and children (including dialogue, play partnering, identities, implicit / explicit instruction vs. exploration)
- How do responses to these questions vary with age?
- How do responses to these questions vary with cultural context?
- How do teachers evaluate children’s creativity?

In terms of the overall research approach, we propose CLS adopts the interpretive paradigm, using phenomenological approach highlighting self-actualising perspective, collecting qualitative data alongside teachers to enable co-interpretation, using methods such as observation (including video material), digital images, outcomes produced by children including
written work, audio recording of children’s learning, discussions with children and teachers (perhaps also including parents), journal entries by teachers. Sample to include classrooms across the 3-8 spectrum in each country (we may need to consider sampling in depth two age groups, one at the end of the project’s age range spectrum, so perhaps one group of 7-8 year-olds and the other at the highest preschool age possible or reception class (4-5 or 5-6). We suggest data collection might span the end and start of school year dependent upon the project’s schedule.
Acknowledgements
Grateful thanks are due to our funders, the European Union for enabling us to carry out this literature review. We are also most grateful to members of the wider Creative Little Scientists team for critical scrutiny of earlier drafts of this review, as well as to colleagues across Europe and more widely who offered perspectives, material and critique. We hope we have produced a review that adequately reflects these points of view and which will appropriately guide the creativity dimension of the next phase of Creative Little Scientists.
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