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1. Introduction

The radical uncertainty that characterises the early 21st century has highlighted the need for creative engagement within education (AUTHOR 3, 2011, 2013; Facer, 2011; Facer et al., 2011). Overlapping spheres of uncertainty generate extreme challenges for the future. These include: environmental change; resource depletion associated with economic globalisation; changing spiritual, religious and political fundamentalist perspectives and associated shifting socio-political values as these conflict with Western capitalism; and the extreme examples of technology transforming human existence (AUTHOR 3, 2005; 2011; 2013). Whilst it can be argued that such radical change demands creativity in response, it is not necessarily evident what kind of creativity might be most appropriate in this uncertain context. Extreme

marketisation and global interconnectedness tends to support the dominance of Western individualisation most aptly articulated through personal consumerism and acquisition (Elliot, 2002). Yet, a growing collection of voices is making a counter-argument. They posit what is actually most needed is a close awareness of and engagement in co-creativity, where shared values are articulated and honoured (e.g. John-Steiner, 2001; AUTHOR 3, 2008). Paramount to this co-creative process of making is acknowledging the process as also having a role in shaping the maker/s (AUTHOR 2, 2008; AUTHOR 2 with AUTHOR 3, 2012; Glaveneau and Tanggaard, forthcoming).

Such an approach to co-creativity that attends to its impact within and beyond the maker/s is positioned in tension with the marketisation of childhood and youth in both analogue and digital contexts, which view children and young people firmly as consumers (Postman, 1983; Lee, 2001; Buckingham, 2011; AUTHOR 3, 2011; Livingstone, 2003). The potential for children and young people to experience this consumer role with only superficial agency—within the Western capitalist, individualist, materialist, winner/loser, values of the marketplace—is high (Montgomery, 2000, 2002). Yet, especially within digital media, young people are also savvy and creative producers of content (Ito et al, 2010; Livingstone, 2009; Marsh, 2005; Stephen, McPake, Plowman and Berch-Hayman, 2008; AUTHOR 1, 2007). Children and young people can thus be viewed as creative multimodal designers empowered through this kind of content production and design (AUTHOR 1, 2009; 2010), with the potential to engage with *possibility thinking* or the transformation from ‘what is’ to ‘what might be’, (AUTHOR 3, 2001; AUTHOR 3 2006; AUTHOR 3, AUTHOR 2 et al, 2008; AUTHOR 3, 2014). This can happen through participation in a digitally connected world via a range of mobile devices including phones, tablets, laptops and gaming interfaces. These offer continuous ubiquitous connectivity with enormously diverse communities of users in terms of location, context and, potentially, values.

Some scholars are studying the tensions and risks involved in being producers as well as consumers (e.g. James et al., 2009). They highlight that issues such as identity, privacy, ownership and authorship, credibility and participation are at stake; they consider how young people might redefine these key concepts and what the pitfalls and affordances might be in so doing. Other researchers emphasise the potency of the activities children and young people are engaged in, particularly beyond school, as agents of their own learning (Buckingham, 2007, Ito

et al., 2013). We engaged in an exploratory research study entitled 'Creative Emotional Reasoning Computational Tools Fostering Co-Creativity in Learning Processes (C²Learn), funded by the European Commission. The research aimed to foster and develop a particular kind of ethical co-creativity through digital gaming and social networking practices with students aged 10 to 18+ through participation within a virtual learning environment (VLE) influenced by our gameful learning design (AUTHOR 1, AUTHOR 3, AUTHOR 2 2014). In what follows, Section 2 provides an overview of the gameful learning design that we provided to our project partners, to guide the design of the VLE using the concept of WHC to develop a new virtual co-creative terrain. Section 3 outlines the origins of WHC and the potential for fostering WHC through C²Learn. Section 4 describes C²Learn's overarching co-creativity framework and WHC's four intertwined features and finally, the paper concludes with Section 5, a presentation of our co-creativity assessment methodology that we argue can evaluate the presence of WHC within VLEs.

2. A gameful learning design

C²Learn employs a gameful learning design that stands in opposition to the more prevalent trend of gamification, or the adding of game layers to an already existing system to increase motivation. Instead the design of C²Learn's VLE, or C²Space (Figure 1), was conceptualised as an integrated gameful learning design where classroom-based educational scenarios provide an agentive framework in which affordances possible in digital games and social networking platforms are used to help deepen students' relationships with real-life contexts through action and play and possibility thinking (Apperley and Beavis, 2011; AUTHOR 2, AUTHOR 3 and AUTHOR 1, 2014). This is more akin to a 'gameful pedagogy' (Feigenbaum and Feigenbaum, 2013) meaning one that emphasizes intrinsic rewards. C²Learn invites students to draw on their gaming literacy and systems-based literacy practices (often inaccessible in school as they are tucked away within their virtual schoolbags) to interact creatively, collaboratively and playfully with each other (AUTHOR 1, 2012; Thomson, 2002; AUTHOR 1, 2010). Our gameful learning design aims to leverage games' deeply satisfying properties (e.g. agency, emotion, and immediate feedback) by providing students with engaging and relevant 'playful experiences' as a pathway to learning.

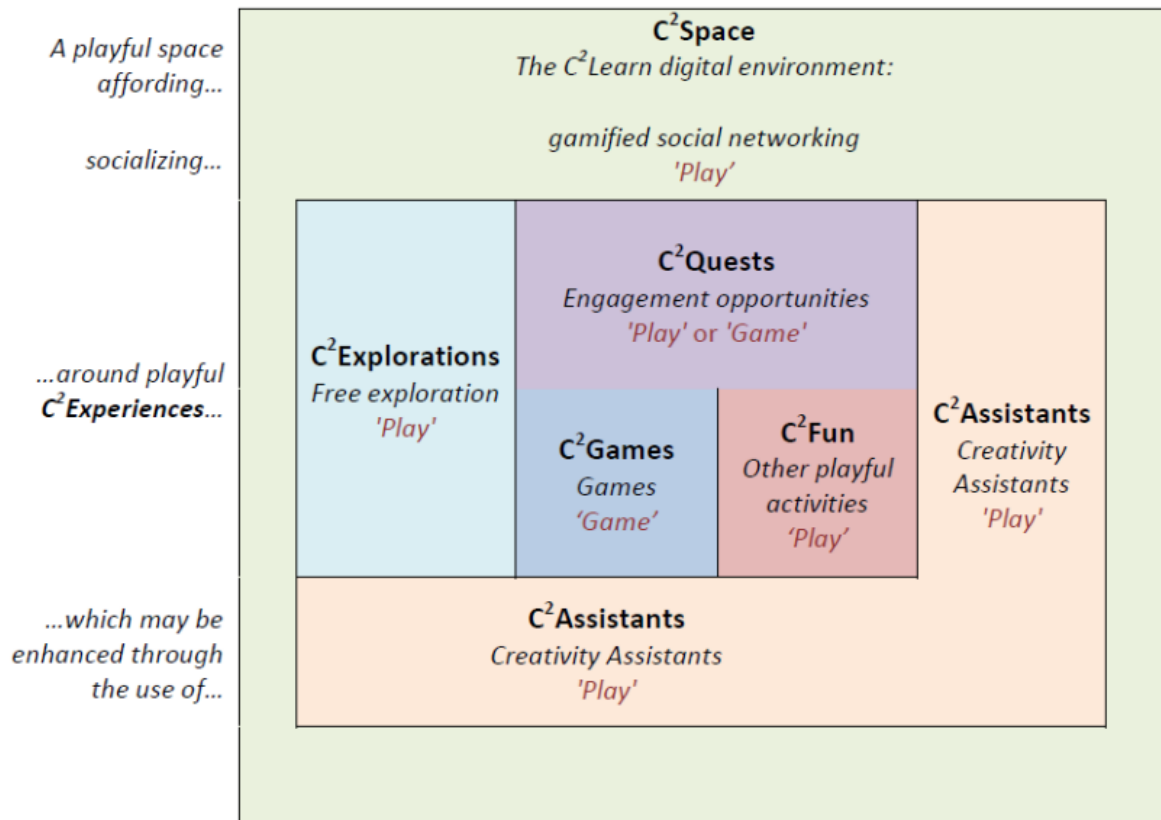


Figure 1: The gameful design of the C²Space (AUTHOR 2, AUTHOR 3, AUTHOR 1 2014)

In C²Learn's VLE, students and teachers autonomously and collaboratively explore new ideas, face and overcome challenges, play games to assist them in reaching their goals and connect with others through engaging in fun, contextually relevant and meaningful playful 'C²Experiences'. The C²Space encourages explorations, games and quests that provide students and teachers with multiple opportunities to put forth new ideas—meaningful to them and their communities—that require them to imagine more new ideas or solve problems via playful experiences, often enhanced by the systems computational tools and artificial intelligence (AI). Participation in the C²Space is intentionally conceptualised to assist students to shift from 'what is' to new possibilities of 'what might be'. In this journey they are assisted by each other and the (AI) or Co-Creativity Assistants (C²Assistants) that interact with them and their teachers to challenge their established linear thinking patterns. The gameful system enables them to use mechanisms of creative thinking and their imagination (embodied through a wide range of potential activities including the arts, technology and sports integrated by the teacher or facilitator).

Prioritising game affordances, including feedback, agency, emotion and relevant challenges over gamified elements (such as points, levels, and rewards or badges, drawn upon in a non-game framework) are the benchmarks of the gameful learning design we provided to C²Learn's game design partners. We argue these types of affordances better intrinsically motivate students and increase their capacity for active learning in a way which is more sympathetic to the wider goal of WHC. This is achieved through the playful C²Experience, as opposed to game orientated strategies of winning or levelling up. This intentional stance addresses the widely theorised critique of gamification within game studies which argues such game oriented strategies provide primarily extrinsic reward motivators (Nicholson, 2012a) that rely on operant conditioning (rewards, points and limited meaning)

We explored the potential of C²Learn's new virtual co-creative terrain, by applying the concept of WHC (AUTHOR 2 and AUTHOR 3, 2011; AUTHOR 2, AUTHOR 3 2011; AUTHOR 3, 2013) to better understand how students and teachers manifest co-creativity (WHC) through engaging in the C²Space. In what follows, we outline the origins of WHC, and then consider its adaptation to a digital environment.

3. Wise humanising creativity (WHC)

WHC emerges from the concept of wise creativity (AUTHOR 3, 2008), a creativity which involves creative stewardship of new ideas towards the collective good and humanising creativity (AUTHOR 2, 2008), meaning creativity which is driven by the embodied dialogic generation of new ideas which are of value to the community and which involves creators in making and being made via 'journeys of becoming' (AUTHOR 2 et al., 2012). WHC is fostered when people have opportunities to engage in collaborative thinking and joint action to imaginatively develop new ideas which are valuable to them and their community. WHC strongly emphasises the reciprocal relationship between creativity and identity. This means that in the process of making or designing, children and young people are also being made; they go on a 'journey of becoming'. And they are doing this in an individual, collaborative and communal way. Crucial to children and young people having new creative ideas is the relationship between their 'inside' and 'outside'. Children and young people can engage in dialogue and share themselves and their ideas (inside) with other people, their ideas and the developing artistic idea (on the outside) (AUTHOR 2, 2008; AUTHOR 2 et al, 2012). Wegerif (2010) suggests that inside/outside

dialogues allow for children to understand ideas, not just learn how to repeat them. Similarly, drawing on Bakhtin (1964), Briginshaw (2001) notes the importance of this dialogue as a means for creators coming up with new ideas. WHC has this notion of dialogue as the generative channel of new ideas strongly at its core; and, drawing on Shusterman (2008), also places an emphasis on these creative dialogues engaging with the physical embodiment of the new ideas, where appropriate, too.

In conceptualising creativity in this way, it is important to emphasise that AUTHOR 2 et al. (2012) acknowledge the multiple tensions and conflicts of creative direction and control, which means that difference is not buried within dialogues. They argue that the idea of creativity being humanising is not intended to mean that it is always fun and positive. Rather it actively acknowledges difference, conflict and negotiation as key to creativity, which may lead, at times to new offshoots of ideas when collaborators cannot agree and they go in different directions; meaning being human is by no means a constantly 'good' or harmonious affair (AUTHOR 2 et al, 2012). In relation to this they are also clear that 'humanising' is not coupled with 'humanism'. Humanising denotes creative activity that pays "more attention to developing compassion, tolerance, highly developed interpersonal skills and respect for difference" (Neeland quoted in O'Connor, 2010, p. 125). Humanist writings (e.g. Maslow, 1987; James, 1905) encompass the idea that humans can have a rational worldview, and that through progress and science they are in control of and can make a better world (Gray, 2002); some strands also suggest that humans are essentially 'good' (e.g. Rogers, 1951). AUTHOR 2 et al. (2012) emphasise that WHC does not emerge from a vision of humanly driven world salvation; it is more aligned with the critiques of humanism (Gray, 2002) which draw on Taoism to argue that human beings need greater humility, to believe much less in our power to control and change the world we live in. AUTHOR 2 et al take account of Gray's argument that human beings are not necessarily innately 'good' and cannot and should not assume supremacy over the environment and other beings alongside which they exist.

AUTHOR 2 et al. (2012) also argue WHC is embedded within the critiquing and debating of what it means to be human in terms of power (Bourke, 2011), where across different cultural contexts, different humanising attributes and power relations might be valued. Bourke distinguishes between human and not human in terms of power, which can be vied for and

manifested in multiple ways. This is in fact, a key dynamic of WHC. AUTHOR 2 et al. highlight that this is not unproblematic in practice, asking ‘whose ethics and whose values?’

Taking into account these previous conceptualisations of WHC, this paper then seeks to focus on articulating the nature of WHC specifically within the C²Learn project’s C²Space or VLE. Drawing on pilot work with British students aged 10 - 16 during the first year of the three-year C²Learn study, we consider how WHC is manifest through four core concepts within the C²Learn project: attending to ethics and impact; engaging in dialogue, being in control and through engaged action; and the ensuing journeys of becoming and quiet revolutions which are explained further in context below.

3.1 The potential of fostering wise humanising creativity (WHC) through participation in C²learn

C²Learn is the first time WHC has actively been conceptualised in a digital context. AUTHOR 3 (2013) has argued for the relevance of WHC in relation to childhood and education in the digital age. From this perspective, she reiterates AUTHOR 2 et al’s (2011) argument that ‘education needs to be imbued with greater creativity, communality, humanity, empowerment and negotiation’ suggesting that ‘uncritical belief in [economic] growth and progress is mistaken’ (2011, 158). We argue that WHC can be fostered through a virtual learning environment like C²Learn and that it can encourage children and young people to challenge the status quo—through and within educational systems. This is because WHC demands everyday, or ‘little c creativity’ (AUTHOR 3 2001; AUTHOR 3, 2005; Beghetto and Kaufman 2007) or the capacity to overcome obstacles and take up opportunities, as distinct from world-changing ‘big C creativity’. This point is integral to how WHC has been developed for application within the gameful learning design of C²Learn.

It is increasingly acknowledged that both adults, children and young people are engaged in fast-paced digital change and they need to find ways to navigate the tensions initiated by this (AUTHOR 3, 2013; Facer, 2011; Thomas, 2011). One suggested route through this is for all involved to use creative potential and wisdom by coupling WHC with ‘possibility thinking’ (PT) and what AUTHOR 3 refers to as the ‘4Ps’: pluralities; possibilities; participation; and playfulness (AUTHOR 3, 2011) to generate ‘quiet revolutions’ or small cumulative changes over time (AUTHOR 2 and AUTHOR 3, 2011). Within the C²Learn project this is exactly how WHC is

framed and facilitated (Figure 2). We have described in detail elsewhere (AUTHOR 1, AUTHOR 3, AUTHOR 2, 2014) how we worked to incorporate WHC into an over-arching conceptual framework which has been developed for C²Learn in order to frame the specific kind of co-creativity that is envisaged within this digital gaming and social networking VLE. Next we provide a summary of this in order to provide context for the rest of the paper.

4. C2Learn's co-creativity conceptual framework

The C²Learn co-creativity conceptual framework seeks to foster WHC (AUTHOR 2 et al, 2012; AUTHOR 2 & AUTHOR 3, 2011) through PT (e.g. AUTHOR 3, 2010; AUTHOR 3 et al, 2012; Cremin et al, 2012), framed by the 4P's (AUTHOR 3, 2011): plurality, playfulness, possibilities and participation. C²Learn seeks to harness and enhance these '4Ps' via Creative Emotional Reasoning (CER), a kind of non-linear thinking enacted through Semantic, Diagrammatic and Emotive Lateral Thinking which results in reframing the ideas in hand in order to contribute to the creative process. This reframing occurs as a result of 'disruptors' or interventions such as a random word, image or emotion produced by the computational tools. Intervention involves the semantic, diagrammatic and emotive computational tools 'stepping into' C²Learn participants' thinking and creative process—by the VLE's AL—in order to disrupt or change how the participants are thinking and acting. C2Learn's AI aims to open up students' and teachers' divergent thinking. The aim is to seek a fusion of CER within WHC with CER's structured techniques taking advantage of and further enabling WHC's creativity opportunities. And in return CER is housed within a much-needed ethical and cultural framework and the most appropriate conditions for fulfilling its potential (AUTHOR 2, AUTHOR 3 & AUTHOR 1, 2014).

C²Learn Co-creativity Conceptual Framework

Pedagogical context within and beyond C²Learn:
valuing learner agency, standing back, time and space, "meddling".

Pedagogic strategies are built into the virtual learning environment
and alongside it (in the classroom) to enable WHC through CER.

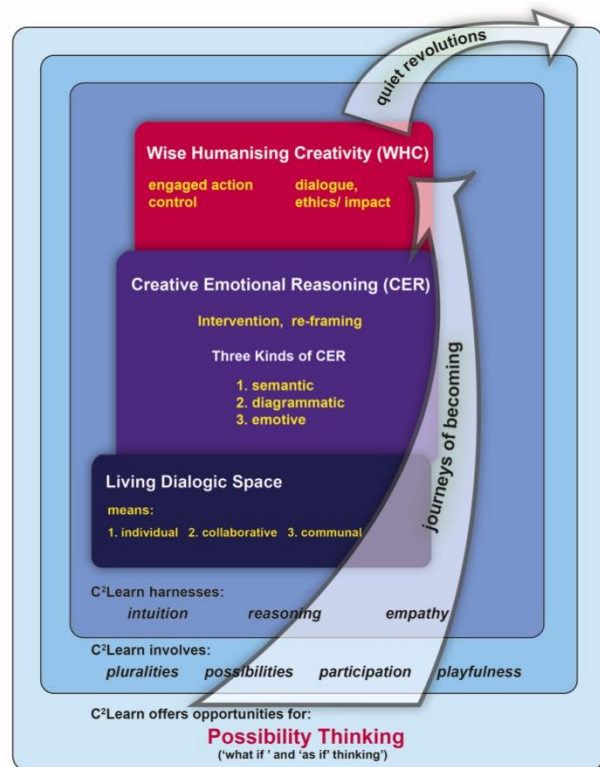


Figure 2: C2Learn's Co-Creativity Conceptual Framework

C²Learn's application of a gameful learning design creates a pedagogic context that also aims to harness intuition, reasoning and empathy within and outside the VLE via C²learn's Living Dialogic Spaces (LDS) (AUTHOR 2 and AUTHOR 3, 2011). These spaces require the dynamic interaction of users (researchers, teachers, students and artists) with the VLE's various C²Experiences to immerse and engage them in activities that have the potential to foster co-creativity individually, collaboratively and communally. LDSs are characterised by debate and difference, openness to action, working 'bottom up' and different modes of idea exchange and have been connected in previous projects with the facilitation of WHC (AUTHOR 2 & AUTHOR 3, 2011; AUTHOR 3 with AUTHOR 2, 2012).

LDS' are therefore embedded within the C²Space and its subcomponents to offer children and young people high participation and shared control, individually, in collaboration and/or as part of a communal endeavour. Within and outside the C²Learn's VLE, interactions will be facilitated through creative learning conversations. The purpose of these is to flatten hierarchies, reposition users in different roles and allow spaces that promote a sense of equality through 'listening' to other users and even allow users to change their mind by identifying with the space of dialogue.

The C²Space digital prototype has been initially conceptualised to work on tablets within living dialogic spaces (LDS) nurtured in the classroom. It aims to facilitate the dynamic interaction of users, with the VLE's various C²Experiences to immerse and engage them in activities that have the potential to foster co-creativity individually, collaboratively and communally. It is important to point out that we do not underestimate the real difficulties of deploying a VLE like the C²Space in the classroom, but the prototype showed promise in pilots (for further details see section 5), particularly in the ways the different gameful design elements have been realised (Figure 6). Within the C²Space, the C²Experiences of the quests, explorations, games and fun activities are supported by the system's artificial intelligence or four C²Assistants: The Mad Scientist; The Wise Oracle; Typical Tom and Progressive Petra who assist users and actively work to disrupt them to open up lateral thinking.



Figure 6: The C²Space digital prototype

4.1 Wise humanising creativity's (WHC) four intertwined features

Within C²Learn's co-creativity conceptual framework, we have broken down WHC into four intertwined features (see Figure 2.). These features were developed specifically for the C²Learn project in the light of WHC's intended manifestation via PT, LDS and the 4Ps in the context of a digitally driven project with the goal to foster co-creativity. The features are therefore differently nuanced to those which have been developed in, for example, arts driven projects (e.g. AUTHOR 2, 2015). It was felt that were WHC to be manifested within the C²Learn VLE, users would:

- **Attend to ethics and impact** by generating, exploring and enacting new ideas with a valuable impact on the community, discarding other ideas that lack such potential;
- **Engage in dialogue** by posing questions, debating between new ideas, finding ways to negotiate conflict or to go in a different direction to others if conflict is not resolved;
- **Be in control** by taking charge of different parts of the creative process, understanding the rules of the system (AUTHOR 1, 2010) and how decisions have consequences, making decisions around new ideas and taking action(s) (AUTHOR 1, 2012) through various challenges or quests, games, engaging and immersive 'fun' activities; &
- **Engage in action** through immersion in the C²Space, and possibly becoming addicted to the exploration and/or the interactive drama played out through the games, challenges, other playful activities. Such immersion would sometimes lead to taking risks and generating surprising individual or collaborative ideas.

Because of the reciprocal relationship between creativity and identity that underpins WHC, through the manifestation of these four features, over time, noticeable changes in players' dispositions, even small incremental personal changes, can result from their WHC, and so players undertake journeys of becoming (AUTHOR 2 et al, 2012).

Cumulatively, and incrementally, the players' journeys of becoming also fuel the potential for individual, collaborative and communal 'quiet revolutions' (AUTHOR 2 and AUTHOR 3 et al, 2011) or small-scale creative change as a result of engaging in the C²Space in which values are to the fore. Hence the quiet revolutions arrow emerging from the top right hand corner of Figure 2. Quiet revolutions are ethically grounded as well as critical, aligning personal with wider values. A quiet revolution, emerging in and beyond the C²Space through collaborative and collective endeavour, is also grounded in excellence and engaged involvement from children and adults in the VLE.

5. A co-creativity assessment methodology to evaluate the presence of WHC in VLEs

Confronted with the challenge of evaluating the extent to which participation in C²Experiences fosters WHC, we designed a co-creativity assessment methodology in close collaboration with C²Learn colleagues from the University of Edinburgh. We designed an integrated approach to

assess co-creativity reflecting the co-creativity conceptual framework. The methodology was designed explicitly to document change and lived experience as a result of engaging in C²Experiences over time in the C²Space (See Figure 2).

A key challenge in creating C²Learn's co-creativity assessment methodology was to productively integrate a mixed approach so as to document 'change', as well as the 'lived experience' of engaging in the project's C²Experiences. The mixed methodology is informed by both the University of Edinburgh's team's experience in evaluation in cognitive science (Stenning and Michell, 1986) and the Open University team's experience in educational/arts informed evaluation (AUTHOR 3, AUTHOR 2; AUTHOR 2). The goal of the co-creativity assessment methodology is to identify the changes and effects to students thinking habits, from their interactions both within the VLE, and beyond in their classrooms.

By 'change' we refer to specific alterations to students' thinking patterns and reasoning processes, expressed primarily in linguistic behaviour, but encompassing other modes as well and manifested in their performance in C²Experiences. By 'lived experience' we draw on qualitative research approaches which foreground meaning made by participants in living through something. In C²Learn we particularly refer to students' and teachers' experience and, in the case of students, self-progression, including the emergence of collaborative or communal ideas or identities through C²Experiences, expressed through dialogue, action and decision patterns, in and around the VLE.

These two dimensions are integrated in the C²Learn approach to co-creativity evaluation, each with a focus on the evolution of participants. We do not aim to evaluate end-results, or products of creativity; instead we seek to precisely document and analysis the process of co-creativity and its impact. This will be done in relation to the ethical frame of C²Learn which, as indicated earlier, seeks to foster WHC through journeys of becoming and involving quiet revolutions.

5.1 Defining C²Learn's co-creativity dimensions

Based on the above considerations, the C²Learn Co-Creativity Assessment Methodology was developed. Table 1, below, presents the research team's approach to the categorisation

scheme to be used throughout the evaluation process. This was designed to mirror and exemplify the core goals of the co-creativity framework including WHC and CER. Here, we focus specifically on the WHC categories. These categories are tailored to the specific kinds of gameplay and social networking experiences that children and young people will engage in through their C²Experiences (and corresponding educational interventions) design process.

Table 1: WHC Elements of Co-creativity Categorisation scheme for C2Learn

Category	Characteristics
Attending to <i>ethics</i> and <i>impact of ideas</i>	<ol style="list-style-type: none"> 1. Creates new associations between ideas 2. Actively explores the consequences of the newly created associations between ideas 3. Exhibits awareness of and concern / interest for the impact of new ideas on the group's values 4. Actively promotes ideas that are deemed valuable by the group
Engaging in <i>dialogue</i>	<ol style="list-style-type: none"> 1. Engages in debate over ideas 2. Promotes dialogue within group (poses questions, respects different viewpoints and/or encourages members of the group to voice their ideas) 3. Actively negotiates conflict and/or seeks alternate path
Being in <i>control</i>	<ol style="list-style-type: none"> 1. Takes a leading role during different phases of the creative process 2. Exhibits a firm grasp of the rules in the system underlying the challenges facing the groups 3. Takes decisions and instigates action
<i>Engaged action</i>	<ol style="list-style-type: none"> 1. Immerses him/herself in the experience of the creative process 2. Facilitates immersion in the experience of the creative process for the rest of the group 3. Willing to take risks and/or leaving his/her 'comfort zone'

All 5 Categories come in 5 levels: 1 [Lowest] – 5 [Highest]. Introducing levels assists us as researchers to ensure we capture C²Learn's impact on students on a full spectrum, and in more detail.

Interrelated data collection

The C²learn evaluation team designed and piloted tools to collect extensive, reliable and interrelated data for detailed analysis to determine the extent to which students' and teachers' participation in the C²Space has the potential to foster WHC. These were:

- Socratic Dialogues with students

A semi-structured dialogue with a group or class of students that begins with open-ended questions with the goal of better understanding the students' reasoning processes and experiences in regards to attending to ethics and the impact of ideas (Scaltsas et al. 2014). Use of the Socratic Dialogues allow students to become aware of reasoning processes and decisions that were implicit in the way he/she handled the C²Experiences by making them explicit through probing questions. The choice of this data collection method reflects the overall aim of the C²Learn project, which is to foster co-creativity. Socratic Dialogues' open-ended questions and overall dialogic form facilitates the task of identifying the creativity one's reasoning.

- Interviews with teachers

Brief (10-15 minute) interviews (one at the beginning and one at the end of the piloting period) with the teachers alongside a small set of field notes from observations of their practice in the case study site in each country. These interviews were audio-recorded, semi-structured and used both closed and open questions to better understand aspects of pedagogy, in particular teachers' perceptions of their students' agency and the extent to which teachers blend 'standing back' with 'stepping forward' and 'meddling in the middle'. The interviews also aimed to explore teachers' perceptions of how actions taken as a result of engaging in the C²Space assist them in assessing their own and students' co-creative endeavours in regards to individual, collaborative and communal creativity and evidence of undertaking journeys of becoming or quiet revolutions.

- Fieldnotes

The researchers undertook field-notes during a minimum of two C²Learn sessions, capturing their own perceptions (Ely, Anzul, Friedman, Garner and McCormack Steinmetz (1991). The fieldnotes informed the interviews with teachers and therefore capture aspects of both pedagogy and learning during C²Learn sessions. They seek to capture evidence of the following aspects of pedagogy (and anything else which seems important to the nurturing of students' co-creativity):

- students' agency;
- teachers 'standing back' to allow students to take a lead, but also 'stepping

forward' and 'meddling in the middle'; and

- use of time and space to enable students' co-creativity

- Video-data Capture

Video of a sample of the dialogues between teachers and students in the classroom as they engage in C²Experiences. The video data is crucial in documenting the artifacts students and teachers create/design during their interaction using the C²Explorations. Collecting film data was deemed necessary as often these artefacts are hard to see or analyse when capture through observation and field notes alone. Video-data capture enables outside raters to make parallel categorisations of children's individual, collaborative and communal co-creativity. This enables the research team to calculate inter-rater reliability kappa statistics. This is the main check for the project that the categories embodying the theory/teaching practice are communicable from teacher to teacher. It is, thus, the main check that we have on the objectivity of the results.

Video capture enables the researchers to identify rich instances of gameplay for analysis to extend the social interpretation of language and its meanings to the whole range of modes of representation and communication employed in a culture (Kress, 2009). Through analysing rich instances, the team can focus on teachers' and students' process of meaning making, a process in which they make choices from a network of alternatives: selecting one modal resource (meaning potential) over another (Halliday, 1978)

- Co-creativity self and peer evaluation tools

Two co-creativity wheels were developed drawing on Redmond (2005) and Spencer, Lucas and Claxton's (2012) creativity wheel design, but using the C²Learn WHC and CER categories to populate the wheels. One was for younger and one for older students, the difference being the accessibility of language. The bespoke C²Learn co-creativity wheels encapsulate the key parts of the C²Learn goals from our co-creativity theoretical framework (Figure 2). C²Learn's co-creativity assessment wheels are a dialogic way of involving pupils alongside teachers and/or facilitators in the co-creativity assessment process whereby they can reflect on their creative development. Furthermore, they are structured to represent a particular way of defining co-creativity and are divided into sections or themes which represent different aspects of the project's co-creativity

definition. The final versions of these are available in the Appendix.

Because the 4P's discussed above were intentionally integrated into our gameful learning design, (participation, pluralities, playfulness and possibilities) and the C²Space, our co-creativity assessment methodology has found ways to enable individual users and peers to self-evaluate the extent to which the C²Learn context allows for possibility and participation.

- Participation and possibility axe

A participation and possibility axe was developed drawing on the Exeter University Aspire project (AUTHOR 2 and AUTHOR 3, 2011) for plotting the participation and possibilities offered by taking part in the C²Experiences within the VLE. The participation and possibility axes (Figure 3) enables students and staff to co-evaluate the opportunities offered and instantiated in C²Learn and ways to develop both where necessary. The axes offer students a means by which to locate their lived experience of participating and generating possibilities by marking their position on a chart, the axes are also used as a prompt for dialogue between peers and also between peers and teachers. They also offer students and teachers opportunities to chart change in lived experience over time.

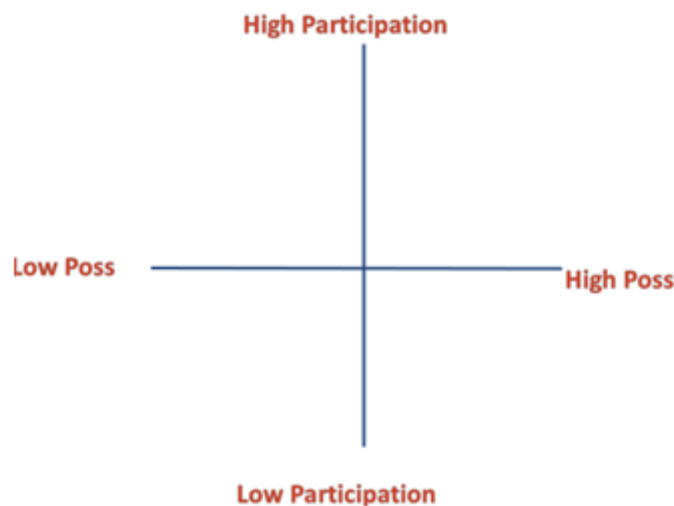


Figure 3: Participation and Possibility axe

The research team developed an extensive Data Collection Protocol which covers in detail the appropriate application of each evaluation tool, as well as the appropriate procedure for collecting and storing data. The protocol clearly articulates when, how, how many times and with whom each tool should be used in each pilot site. The evaluation team also carried out a trial of moderated data collection and analysis using each of the tools at a pre-pilot in Greece of

students playing a pilot paper prototype of a C²Learn Game. This was done to insure researchers across the project's three countries (Austria, Greece and the UK) could correctly apply and use C²Learn's Co-Creativity Assessment Methodology's tools, protocols and categorization scheme. After the pilot, the methods of data collection and data collection protocols were updated and refined for 2015, when the project is undertaking a study of the fully developed C²Space.

From 2014 to 2015, the co-creativity assessment methodology was piloted in England, Greece and Austria across the primary and secondary age ranges. Within the pilots, this new co-creativity assessment methodology explores how participants manifest co-creativity or WHC through C²Learn's experiences and how their manifestation of co-creativity or WHC in C²Learn changes over time. The co-creativity methodology has been operationalized to evidence how WHC manifests in VLEs across the age ranges, and its potential to develop more nuanced understandings of creativity within this arena (AUTHOR 2 et al., under review)

A new way of fostering wise humanising creativity in VLEs and new educational futures

The paper has offered an overview of the C²Learn gameful learning design, outlined the origins of WHC and the potential for fostering WHC through the C²Learn VLE. It has also described C²Learn's overarching co-creativity framework and WHC's four intertwined features and detailed the way in which these features have been articulated within the co-creativity assessment methodology to be used for evaluating the presence of WHC within VLEs. In this final section we draw together the arguments for the application of WHC as an important way of conceptualising creativity within VLEs and its implications for digital educational futures.

We argue that if we can demonstrate WHC in evidence during children's and young people's C²Learn experiences, WHC not only has the capacity to provide a new way of considering creativity but it also has the capacity to broaden people's perspectives on the purposes of education per se. This is because this ethically framed creativity foregrounds the role of values in generating fundamental small-scale creative change or 'quiet revolutions'. With its heritage in AUTHOR 3's (2005) debates about the tensions and dilemmas of creativity in education, WHC does this by problematising the marketisation of childhood and youth and offers new ways of

considering educational futures including implications for the theoretical understanding of creativity within VLEs and their use within education.

We believe there is already evidence that WHC brings with it assumptions about childhood which reflect a positive and optimistic understanding of how childhood is changing and of the affordances of VLEs in relation to this. We argue that WHC, along with the tools to evaluate it, together with mixed digital and analogue approaches to classroom practice, which are mindful of gameful design, are powerful ways of developing preferable education futures over probable one (Inayatullah, 2008). This is because they allow us to conceive of education's purpose as being much broader than serving the formal economy. VLEs, like the C²Space, offer new exciting contexts via which students and teachers can rethink education's role in creating citizens and social beings. These citizens can potentially open up virtual problem spaces, and can work co-creatively by engaging in lateral thinking with each other and the system's artificial intelligence, to live in and act upon the world, with a goal of acting on the world beyond the VLE itself.

C²Learn is designed with the aim that co-creativity involves changing pedagogy and learning, unleashing learners' and teachers' creative potential, transforming the traditional educational process and generating new preferable education futures. As students question assumptions and responsibly generate new ideas, changes and solutions with each other and with the VLE's artificial intelligence, education stands a chance of actually "mitigating inequalities and in contributing to the creation of fairer and democratic futures" (Facer, 2011, p. 9). We would envisage that teachers and students using C²Learn's VLE, will embark on journeys of becoming over time and move away from learning about unquestionable facts, to thinking differently and questioning the obvious and widely believed. Co-creatively they will work together to generate new ideas, proposing new solutions and implementing changes, feeling, understanding and responsibly managing the usefulness and impact of novelty on themselves and the others. C²Learn unequivocally draws on the playful digital practices that remain securely tucked inside students' virtual schoolbags (Thomson, 2002) in ways that draw on their individual, collective and communal funds of knowledge (Moll et al., 1993) to make schooling more relevant to their lifeworlds (AUTHOR 1, 2010).

What makes C²Learn different is the VLE's gameful design where students undertake creative quests. We argue that, because the VLE is playfully designed, the students are more intrinsically motivated to take journeys towards specified goals they articulate themselves through meaningful missions and quests. The C²Space's AI or C²Assistants actively help to make missions and quests a playful experience where through play and action (Beavis and Apperley, 2012), students become immersed in activities within gameplay and social networking making the experience less of a traditional lesson and more fun, but at the same time important to them and the others. The C²Space helps teachers and students work together to turn education on its head (Facer, 2011), where through completing challenges and missions, their play and action encourages them to challenge hegemony. In particular, it encourages challenges to formal education as a preparatory exercise for children and young people where they fall into the social and technological demands of society (Baker, 2009; Facer 2011). We anticipate, a trajectory with C²Learn more along the lines of a virtual 'collaboratory' where children and young people alongside their teachers and AI imagine a new common vision for the future and develop their own prototypes for immediate action (Muff, 2014). The collaboratory is a blended word that fuses 'collaboration' and 'laboratory'. It is a:

facilitated space open to everybody, and in particular to concerned stakeholders, to meet on an equal basis to co-create new solutions for societal, environmental or economic issues by drawing on the emergent future. It is a place where people can think, work, and learn together to invent their common futures (Muff, 2014, p.9)

The C²Space is essentially a virtual collaboratory, where students engage in co-creative endeavours and reflect on their co-creativity. Here they shift from being students to being creative multimodal designers (AUTHOR 1, 2009, 2010) empowered to invent their respective futures by engaging in *possibility thinking* or the transformation from 'what is' to 'what might be', (AUTHOR 3, 2001, AUTHOR 2 et al, 2008, AUTHOR 3, 2014). Within the C²Learn's VLE, they have unprecedented opportunities to reflect on the potential value and impact of their creativity as well as on how they and others may be changing little by little, what this change looks like, what has enabled it and where it is taking them next. This is about players' collective journeys of becoming combining together incrementally and cumulatively to contribute to ethically considered group change via quiet revolutions. This takes us beyond purely

competitive, innovation-focused engagement in digital educational environments and harnesses creativity and educational futures together whilst thinking about impact. It seems increasingly clear from initial and current piloting (AUTHOR 2 et al, in review) that using WHC to conceptually frame and design this digital gaming and social networking environment takes students' playful digital practices out of their virtual school bags and into their learning. What remains to be seen is the potential scale of the creative, quiet, educational revolutions that may be possible in the VLEs when they come to fruition.

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Finally we would like to remember AUTHOR3 who sadly died during this project. It is because of AUTHOR3 foresight and vision that our work on the C²Learn project was possible. Despite missing AUTHOR3 we are glad to have been able to see the project through to fruition so that children, young people and teachers across Europe can benefit from project outcomes inspired by AUTHOR3 and her collaborative ideas and work on creativity in education.

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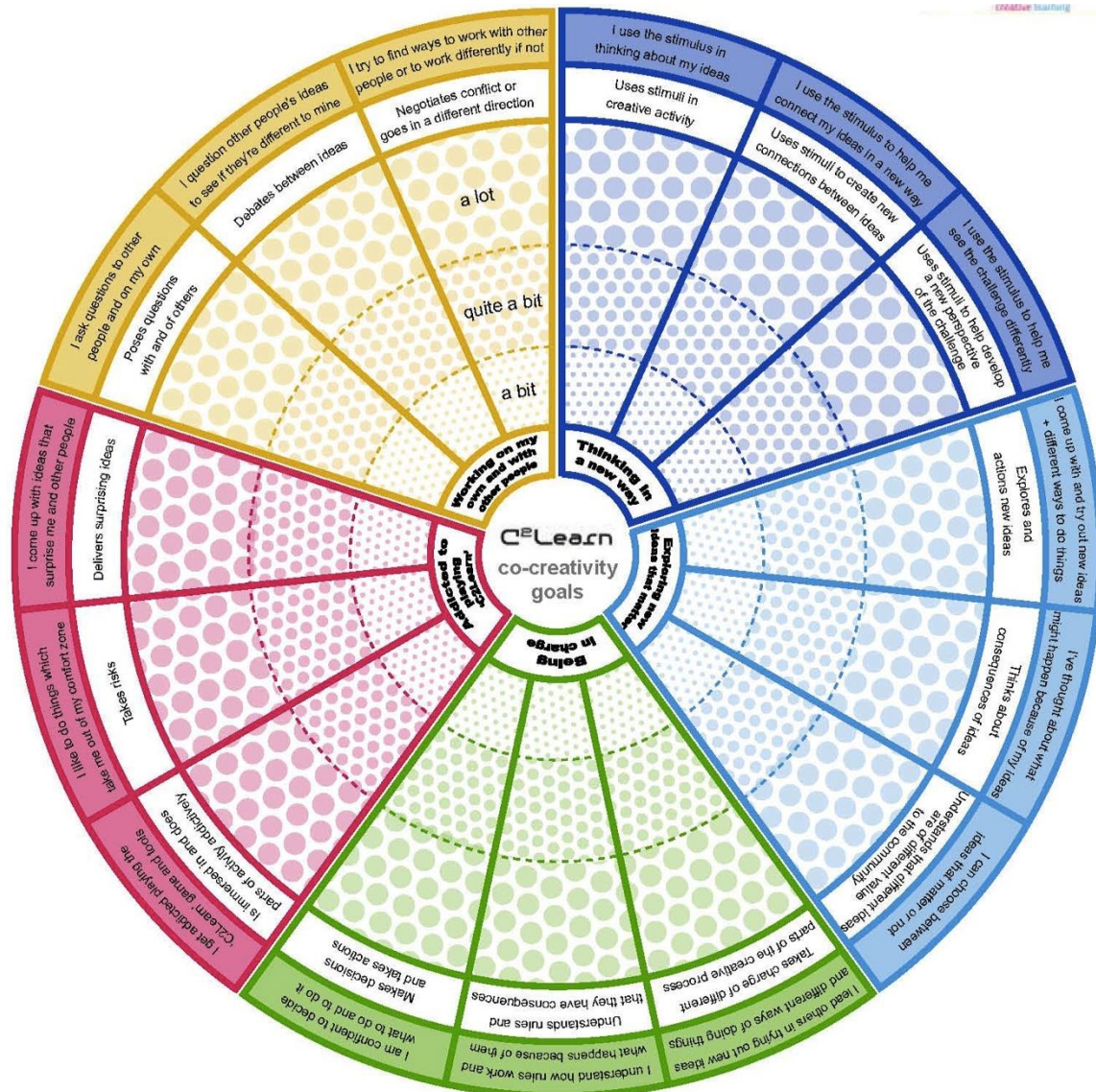
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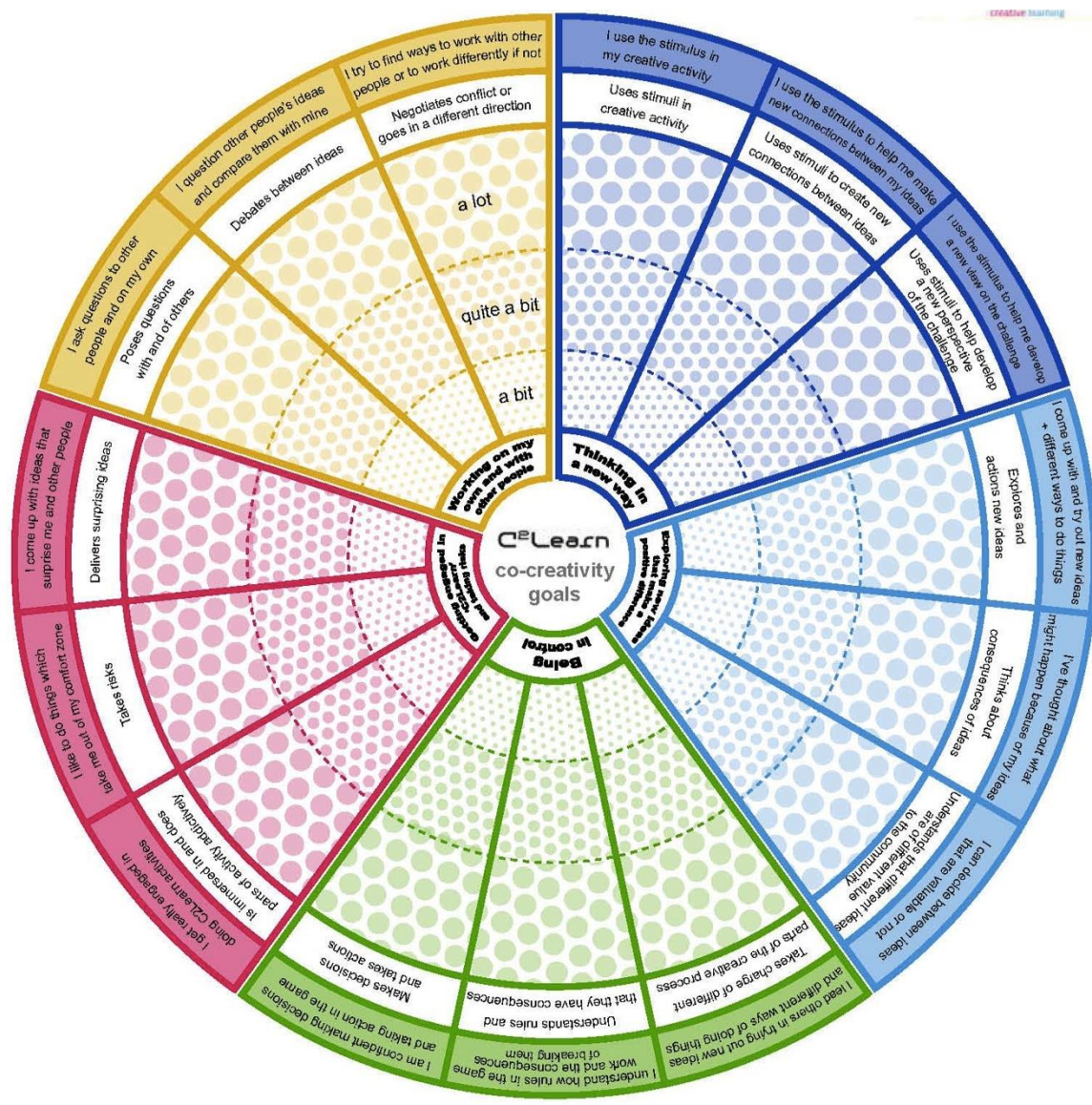
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Appendix: Co-creativity wheels



Primary and younger secondary students

Put a tick mark (✓) in one box under the statement to show whether you agree a bit, quite a bit, or a lot.



Older secondary students and over 18s

Put a tick mark (✓) in one box under the statement to show whether you agree a bit, quite a bit, or a lot.

