



Creative Emotional Reasoning Computational Tools Fostering Co-Creativity in Learning Processes

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CO-CREATIVITY EVALUATION ANALYSIS

C²LEARN PROJECT DELIVERABLE NO. D5.4.2

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¹Very sadly Professor Anna Craft died while the first installment of this Deliverable was being prepared. The team would like to acknowledge her leadership and contribution to the C²Learn project, and all its outcomes, even though she is no longer with us.

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EXECUTIVE SUMMARY

C²Learn at a glance

C²Learn (www.c2learn.eu) is a three-year research project supported by the European Commission through the Seventh Framework Programme (FP7), in the theme of Information and Communications Technologies (ICT) and particularly in the area of Technology-Enhanced Learning (TEL) (FP7 grant agreement no 318480). The project started on 1st November 2012 with the aim to shed new light on, and propose and test concrete ways in which our current understanding of creativity in education and creative thinking, on the one hand, and technology-enhanced learning tools and digital games, on the other hand, can be fruitfully combined to provide young learners and their teachers with innovative opportunities for creative learning. The project designs an innovative digital gaming and social networking environment incorporating diverse computational tools, the use of which can foster co-creativity in learning processes in the context of both formal and informal educational settings. The *C²Learn* environment or **C²Space** is envisioned as an open-world 'sandbox' (non-linear) virtual space enabling learners to freely explore ideas, concepts, and the shared knowledge through participating in **C²Experiences** assisted by the systems artificial intelligence (AI) known as **C²Assistants** (Figure 1). This innovation is co-designed, implemented and tested in systematic interaction and exchange with stakeholders following participatory design and participative evaluation principles. This happens in and around school communities covering a learner age spectrum from 10 to 18+ years.

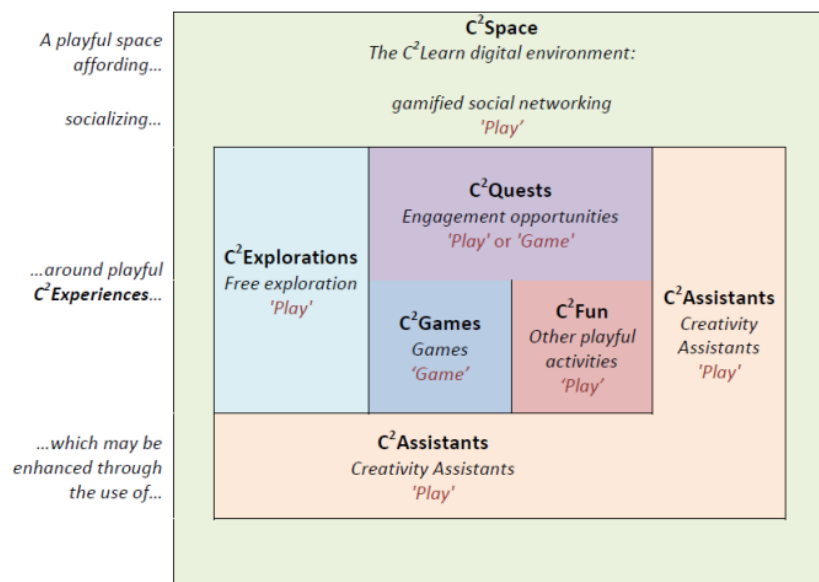


Figure 1: C²Learn's C2Space and its subcomponents

About this document

Deliverable 5.4.2 is the final installment of a document describing the outcomes of qualitative and quantitative **Co-creativity Evaluation Analysis** of data and information gathered through the pilot activities (M21, M30 and M36 cycles), following the methodology

defined by T2.3. Led by the UEDIN team, in close collaboration with OU, EA and BMBF it sets out in detail the qualitative and quantitative analysis performed, according to the defined conceptual foundations and assessment methodology of the project (D2.3.1-2), leading to a synthesis of the pilot findings. This is complemented by a review of the Socratic Dialogue tool, in light of the pilot findings.

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LIST OF ABBREVIATIONS AND TERMS

A) Abbreviated names of the project consortium partners

Abbreviation	Explanation
EA	Ellinogermaniki Agogi, Greece (coordinator)
UEDIN	The University Of Edinburgh, UK
OU	The Open University, UK
NCSR-D	National Center For Scientific Research "Demokritos", Greece
UoM	Universita ta Malta, Malta
SGI	Serious Games Interactive, Denmark
BMBF	Bundesministerium für Bildung und Frauen, Austria (Former: BMUKK)

B) Other abbreviations

Abbreviation	Explanation
CER	Creative Emotional Reasoning
LDS	Living Dialogic Space
MIA	Multimodal Interaction Analysis
SD	Socratic Dialogue
WHC	Wise Humanising Creativity

1. INTRODUCTION

The present document, deliverable D5.4.2, is the final installment of a document describing the outcomes of the Co-creativity Evaluation Analysis of data and information gathered through the pilot activities (M21, M30 and M36 Pilot Cycles), following the methodology defined by T2.3. Led by the UEDIN team, in close collaboration with OU, EA and BMBF, it sets out in detail the qualitative and quantitative analysis performed, according to the defined conceptual foundations and assessment methodology of the project (D2.3.1-2), leading to syntheses of the pilot findings. This is complemented by a review of the Socratic Dialogue tool, in light of the pilot findings.

2. UK AND AUSTRIAN PILOT (M21 CYCLE) ANALYSIS SYNTHESIS

This section synthesises the common analytic outcomes, as well as the differences, in response to the C²Learn Research Questions, based on formal analyses of the UK and Austrian data, from the M21 Pilot Cycle.² It must be remembered that the Austrian data was collected within an intensive week of secondary school piloting in one school and the UK data was collected across one primary and one secondary school site working over longer time periods. This difference in context and longevity was considered as part of the synthesis and is commented on as appropriate across the writing below.

This synthesis of the more formal analyses of the UK and Austrian pilot data is generally in agreement with the informal findings from the Greek pilot.

1. How do participants manifest co-creativity (WHC and CER) through C²Learn gameplay?

The analysis for Question 1 uses the Co-creativity categorisation framework to structure the Findings:

2.1 SYNTHESIZED COMMENTS ON CO-CREATIVITY

In the UK especially, there was discussion from the students that suggested they felt that “creativity”, and “imagination” might exist in the game per se. UK teachers had mixed views on whether students were being creative in their thinking process. On the one hand they thought they were thinking creatively when, for example, they made connections between 4Scribes cards, on the other hand they thought they weren’t thinking creatively enough, especially in terms of being too literal when interpreting cards. In Austria, there was much less discussion of creativity per se within the game, with evidence regarding creativity closely related to the WHC categories. In Austrian discussions though, there was articulation of the “playful” and “motivational” benefits of the game per se in relation to learning.

² For a comprehensive exposition of the UK, Austrian and Greek per-site data analyses and findings, see D5.4.1.

2.1.1 ETHICS AND IMPACT OF IDEAS

(Generating, exploring and enacting new ideas with valuable community impact (discarding other ideas that do not.)

There was a very small amount of data to indicate that some of the UK primary and secondary students and some of the Austrian students may have been paying attention to ethics and impact. In the UK, this came from teachers noticing that some secondary students were knowingly negatively disrupting fellow students' directions of play. Although others of the UK secondary students felt they were developing new ideas which made a 'positive difference' "quite a lot"; this was registered both through their wheel scores and reported on in the students' interviews. Secondary students' interviews in Austria and the UK and the primary teacher interview also exhibited primary and secondary students weighing up the 'pros and cons' of pushing their own 4scribes ending or that of others, as well as debating the most interesting elements of their stories on the grounds of their ethical impact (eg the right person being allowed to survive in the story). Although the UK primary and secondary teachers especially felt that the students were not referring directly to ethics, there were some hints that the UK children and young people were thinking about the rights and wrongs of how they structured the story and how this impacted on their fellow gamers. The evidence for the Austrian secondary students, specifically in terms of the teacher's commentary, showed that thinking about ethics was more explicit. Examples include applying empathy to prevent negative outcomes, selecting a 'better' person to survive over a more superficial person, debating ideas such as "compassion" and using their card intervention to ensure a protagonist's well-being. This was supported by the students' own ratings of themselves as 'quite a lot' or 'a lot' on this category on the creativity wheel.

2.1.2 ENGAGING IN DIALOGUE

(Posing questions, debating between ideas, finding ways to negotiate conflict or to go in a different direction to others if conflict not resolved.)

The UK secondary teachers described how there was not much debating and that gameplay was "largely individual" and this comment was supported by some of the students' creativity wheel data as well. UK secondary data also illustrate that where debate occurred it could be quite competitive as well as some examples of the more negotiated dialogue which are part of WHC, as well as students understanding the role of difference within the story-telling process. The UK primary students showed very little evidence of dialogue as a result of playing 4Scribes, according to the teacher's interview. In contrast to the two UK sites, the Austrian data showed strong instances of dialogue across gameplay with participants discussing "juggling ideas and thinking about the consequences of their actions". However it must be noted that the Austrian students elected to change the rules of 4Scribes before they began play so that everyone could see everyone else's cards. This perhaps removed the element of competition and non-collaboration that had been holding back the UK students from engaging in more dialogue, and allowed the most involved of the Austrian students to really negotiate their ideas and how they fitted together.

2.1.3 BEING IN CONTROL

(Taking charge of parts of the creative process (understanding rules of the system, decisions have consequences, making decisions, taking action.)

The UK secondary data showed a variety of takes on the idea of 'Being in control'. It translated as students *not feeling in control* due to the way the 4Scribes rules made them play. It also translated as students *taking control* to play strategically around some of these issues in order to lead the story to their desired ending. UK primary students also showed evidence of *being in control* as well as wanting to be in control of the game; and both sets of UK students showed evidence of using humour as part of achieving this. This range of types of control is perhaps reflected in the UK secondary students' responses on the creativity wheel where students mostly responded on the middle level, with one on the lowest level. Interestingly the UK secondary teacher questioned whether having to have a winner forced a level of competitiveness which was detrimental to fostering their co-creativity, which links to the point above regarding Austrian students being able to remove competitiveness in favour of collaboration by showing each other their cards. The UK secondary teacher also pointed out that they thought that overall the detachment between player turns limited any tactical manoeuvres, and in turn perhaps the control the students felt they had over the game. The UK primary teacher recognised that the possibility of *being in control* in a competitive way was perhaps not an advantage as it allowed more dominant children to take the lead. Similar relationship dynamics were identified in the Austrian secondary student groups with, despite the best efforts of students who noticed the imbalances in control and tried to rebalance them, some students took such passive roles that they asked their group leader what to write on the card. Stepping back more generally to consider the Austrian secondary data though, there was evidence of most of the participants being able to exert *some kind of control* over gameplay and of their creative experience through it, via transforming the meanings of cards, and even going so far as to create an unrequested rap (spoken word poetry) out of their story. The Austrian researcher highlighted students *being in control*, both individually and as a group (apart from the one student indicated above in the passive role) as a strong factor in the development of the game, with them going so far as changing the rules across gameplay and disrupting the initial input from the teacher.

2.1.4 ENGAGED ACTION

(Being immersed in the experience. Being addicted, not able to stop, trying repeatedly. Such immersion sometimes leads to taking risks.)

In the UK secondary data there were differences in reporting from different data sources regarding engaged action. 3 out of the 4 students indicated that they felt that they had been engaged or 'immersed' in the experience 'Quite a lot' and this was supported by the UK secondary film data showing students *deeply engaging* in developing surprising story lines. And yet, both UK secondary students and teachers reported in interview that the wait between turns was seen to cause a lack of engagement in the game, with some students almost completely disengaged in between turns as the teacher allowed them to read a book. Therefore, although the creativity wheels and film data indicate bursts of engagement were

possible when players had their turn, a longer kind of immersion in the game in the UK secondary site was not possible in its current format. In contrast, the UK primary teacher reported that the children wanted to continue playing after the pilot as they understood the game better, the more engaged they became, although also indicating that their engagement might be due to the competitive nature of the game. In the Austrian secondary site there also seemed to be a range of engagement in the game, which might have been connected to the meaningful interlinking of learning activities and their relationship to who was in control of group dynamics, with the suggestion that *those more in control were more engaged*. There was also evidence from one of the Austrian groups of extremely deep immersion in the C²Learn gaming activity which saw them gaming in their non-contact time, creating a DVD cover, writing a script – all unrequested by their teacher. The Austrian researcher commented on the implications of this for the development of C²Learn activities in the classroom more widely and understanding how the activities could build into other non-digital teaching and learning in different curriculum areas.

The Austrian researcher highlighted a possible extension of the engaged action category which will need further investigation in the next stages of piloting to verify it. This was the notion of *collaborative transformational agency* where students' and teachers' lived experience saw collaborative agency as a great driver for engagement in their class and beyond. In the Austrian analysis, the experiences of collaboratively transforming meaning by the students emerged throughout the pilot phase. It is difficult to judge whether this collaborative transformational agency was due to the intensity of the Austrian pilot which occurred during a one week intensive workshop based on curriculum crossing domains (German, music, IT). From here this theme needs to be considered across the UK and Austrian sites in the next C²Learn pilot in order to try to ascertain whether it has the potential to occur in other C²Learn sites too as a part of C²Learn gameplay.

2.1.5 INTERVENTION AND REFRAMING

(Specific changes in thinking patterns, and in particular reasoning processes. Changes in expression, primarily in linguistic terms, but also encompassing other modes as well.)

In the UK sites, intervention and reframing was the least consistently evidenced of the five co-creativity criteria, despite the fact that on the creativity wheels all the students marked themselves in this category as 'Quite a lot'. UK students were able to comment on being able to "*disrupt*" thinking and being aware of their power to change the direction of the story and in so doing develop new ideas. These were found in relatively isolated incidents within quite short stretches of UK gameplay but their existence does seem to indicate that intervention and reframing might be possible within this gaming context. Within the Austrian data intervention and reframing was found to be a much more constant activity in the C²Learn pilot experiences, because every time students played a card they intervened and told the ongoing story differently, so they reframed what had been given initially. It may be though that this represents a more open interpretation of the category than in the UK data analysis. This issue of interpretation may need attention in the next round of piloting and will be aided by the incorporation there of data analysis from the Socratic Dialogues which was not present in this piloting phase.

2.1.6 4Ps

(Evidence of high participation [engagement and involvement], high pluralities [taking on many roles, personae, perspectives], high playfulness [operating in an as if and playful manner] and high possibilities [generating many ideas through what if and as if thinking].)

In the UK sites, students expressed differing views about their participation and possibilities in the game. The two students that marked themselves as relatively high on participation described their gameplay as “fun” and “exciting”. This was supported in the video capture where they appear to enjoy the competitiveness of disruptor gameplay where they exhibit possibility thinking within a playful role. For example, one student contributed a very imaginative twist to the story which illustrated his imagination and the accompanying possibility thinking at play. Possibility thinking was also evidenced in the UK in post gameplay discussion, when students were thinking of ways in which the game could work in school. In English they believed it could be a revision activity, with certain vocabulary or punctuation being incentivised. They also saw the potential for using the game as a story telling tool. Even though one student marked herself into the negative zone on participation and possibility, on the film capture she animatedly found a way for those who had been left behind to be reintegrated into the story. This illustrates participation in picking up on and developing part of the story line perhaps a little more than her own grading gives her credit for on the Axes. UK teachers reported they believed 4Scribes had real potential for combining playfulness and possibilities. One SE teacher mentioned that he could perceive the benefits of “disciplining their creativity”, because he saw this as good for students’ thinking skills. This perhaps relates to how he perceived the quality of the students’ participation. Importantly, the UK teachers recognised the need for more playing time in order for the students to get comfortable enough to start to think ahead during gameplay. There was little evidence of discussion of the idea of pluralities in the UK, but this is likely because of the limited nature of the piloting and the prototype in this phase.

The Austrian secondary data illustrates self-reported high possibility and high participation by all students involved. All gameplay activities had a strong group dynamic and different degrees of high participation, where at times there were leaders, who took control over almost the activities and others have been rather passive, but still report high participation and possibilities. One student on the lower spectrum of high participation stated on interview that she liked the gameplay activity but she is not good friends with the leading participants and as a result felt demotivated due to the group dynamic, but not due to the gameplay

2.1.7 UNDERTAKING A JOURNEY OF BECOMING

(Over time, noticeable changes in participants’ dispositions and/or personalities. This may involve smaller incremental changes.)

Due to the very short timescale of the pilot, there was limited evidence of ‘journeys of becoming’. With the longer pilot timescales in forthcoming, we hope to find robust evidence of noticeable changes (even small changes) in students’ and teachers’ dispositions and/or

personalities. In the Austrian site, the researcher observed an *incremental and cumulative change* in one student's dispositions and/or personalities who was new to the class. At the beginning of the pilot, the student was very cautious and self-contained but as gameplay continued over the course of the one week intensive, the student became highly engaged especially when the students collaboratively transformed the story into a screenplay that was produced into a film. At the end of the pilot, when his group showed the film and everybody was watching, his heart started to pump so hard, that he showed everybody his chest and how it moved with the heartbeat. On film, he exclaimed with a surprised smile, "I have never felt something like this before". This example succinctly illustrates one participants' journey of becoming, as he transformed from a newcomer to what the teacher has described as 'the hero of the group'.

2.1.8 GENERATING QUIET REVOLUTIONS

(Over time more noticeable changes in the creative community stemming from creative ideas generated; might comprise smaller incremental changes.)

In the UK, the short time frame of the pilot limited to possibilities to generate quiet revolutions, yet one noticeable change was that the students' exhibited more confidence amongst themselves. The teachers also commented that was evident amongst the group of students and believed if 4Scribes was used with more students at scale, rather than just the pilot students who volunteered, it likely had the potential to boost student confidence more generally. This highlights the *potential for change* might be possible through gameplay and immersion in C²Learn gaming and social networking environment and that researchers should remain alert to this during the next piloting phase. In the Austrian site, like due to the compressed timescale, quiet revolutions were not observed, but what was observed was students revisiting their playing 4Scribes and the collaborative stories they authored. The Austrian researcher noted the group grew more cohesive as a result of this revisiting activity. This is something to be considered in the subsequent pilot, the idea of revisiting collaborative storylines and the possibility of generating quiet resolutions upon reflection of gameplay.

2.1.9 PEDAGOGIC STRATEGIES

(Evidence teachers proactively valuing learners' ideas and actions; enabling learners to take the initiative; ensuring sufficient space and time for ideas and actions to emerge getting alongside the learner and learning as fellow collaborator.)

In the UK, on interview the teachers concluded, upon reflection, that they had used different pedagogic strategies. Some were practical differences associated with a small group and a high teacher: pupil ratio and 'teaching' with two teachers. However these changes are more related to the piloting circumstances than the C²Learn experience per se. In the open-ended Socratic interview in the SE of England teachers discussed how 4Scribes gameplay is useful because it "encourages you to prompt without telling" and that "that kind of open ended questioning teaches valuable lessons as a teacher". Both SE teachers also reported having to hold back during play, and this is clearly related to the C²Learn pedagogy of standing back,

meaning that for teachers to allow creativity to happen they need to know when to stand back and let students take control. This example perhaps provides a little evidence that standing back was occurring around these short episodes of gameplay and this this will be important to highlight in subsequent pilots. In the SW of England, the teacher only had a short amount of time to try out the game with students so there was less comment on pedagogic strategies. However, he did make recommendations for future gameplay. He suggested not using the randomised premise and allowing the children to generate their own premise that might have more relevance to their lifeworlds. He also discussed how relating story ideas to curriculum areas in the future would be fruitful; this is obviously something the school will be able to pilot in the next phase of the project. In the Austrian pilot there was not an explicit focus on pedagogic strategies, rather the focus was on facilitating gameplay.

3. UK AND GREEK PILOT (M30-M36 CYCLES) ANALYSIS SYNTHESIS

This section synthesises the common analytic outcomes, as well as the differences, in response to the C²Learn Research Questions, based on formal analyses of the UK and Greek data, from the M30 and M36³ Pilot Cycle (Primary school).

	English primary 1 (SE)	English primary 2	Greek primary
Contextual information	<p>Gameplay took place across 3 sessions with 3 classes of year 5 and 6 children. Game play was across 3 sessions and three classes of year 5 and 6 children, using paper prototypes. A research visit in February worked with 2 groups of 4 children (2 male and 2 female in each group). These eight then disseminated their learning to their classmates between visits. In March a follow up research visit worked with 24 children in 6 groups.</p>	<p>Game play was across 5 sessions and 4 groups of 4 year 5 children, using galaxy tablets, and accessing the 4scribes tool. A research visit in May worked with one group of 4 children. In June a follow up research visit worked with three groups of 4 children. One group in this second visit began with digital tools, however technical difficulties meant that they completed their gameplay on paper.</p>	<p>Game play was across 2 sessions and one class of year 6 children, using digital and paper prototypes. The classroom was divided into 4 groups. Each group consisted of three teams. Each team includes two players. This research worked with one focus group of 6 children. In addition to this focus group, this paper involves analysis' comments for the whole class. The first visit to this 6 grade classroom was at 17th of March 2015 and a second round took part at 28th of April 2015. Students played a 4scribe (basic version) history lesson scenario (2 hours) [scenario: How you can live under social and economic rules of Ottoman Empire] and a 4scribe (basic version) geography scenario (2 hours) [scenario: You lost in a mountain and you are seeking how you will go back] in digital or paper-based form (due to technical problems). In addition to the previous implementation, researchers attended to the classroom two additional hours applying SD and filling in the research forms. All students created their own pseudonyms so as to complete researcher's form. It is important to underline that students did not use their pseudonyms during game play but only when they completed the researchers' forms.</p>

³ Data examples across M30-36 analysis are referenced from: Chappell K., Walsh C., Kenny K., Wren H., Scmoelz A., & Stouraitis, E., "Wise humanising creativity: changing how we create in a virtual learning environment", *Digital Culture and Education*, 2016 (Under review)

			24 students (13 girls- 11 boys) 12 years old and the second one 22students (12 girls-10boys) 12 years old.
Data collection	1 teacher interview conducted by telephone after session 3. 8 axes and wheels were filled in after session 1 and 14 student axes and creativity wheels were completed after session 3. Film and audio footage from sessions 1 and 3 were recorded.	1 teacher interview, notes embellished post interview; 4 x student axes and creativity wheels completed once after 1 st research visit (session 3); 12 x student axes and creativity wheels completed after the second research visit, session 5; film and audio footage and photographs of play from sessions 3 and session 5 (2 recorded by the researcher, and one by the teacher); SD interviews carried out by researchers after gameplay in session 3. Notes from teacher following a plenary discussion following session 2. Research visit 2, (session 5) was time pressured so SD data collection was limited.	2 teacher's interviews, 2 audio game playing and relevant photographs, 2 game playing' film, 2 SD, students axes and creativity wheels completed after the two implementations, researchers' field notes, 3 important things after game playing, 3 important things after SD
Data processing	The researcher who had collected the data, carried out the first low level analysis, starting with rich instances in the film footage or audio, followed by axes and wheels, then supported by teacher interview. Then a senior member of the research team read and commented on the credibility of the analysis as a means of triangulation, and the original researcher made any necessary changes to the analysis following discussion.		Teacher and student interviews analyzed by researcher 1 and 2 with rich instances viewed and integrated with interview analysis. Researcher 1 verified researcher 2's film footage and interview analysis

Table 1: Methodological information for UK and Greek Primary School analysis

3.1 SYNTHESIZED COMMENTS ON CO-CREATIVITY

Despite these pilots being very short, with no game play in between and some of the data collection methods not being used, there is a small amount of data via the analysis of which the research team has been able to respond to the 4 research questions detailed below in the primary context.

1. How do participants manifest co-creativity (WHC and CER) through C²Learn gameplay?

The analysis for Question 1 uses the Co-creativity categorization framework to structure the Findings:

3.1.1 ETHICS AND IMPACT ON IDEAS

(Generating, exploring and enacting new ideas with valuable community impact [discarding other ideas that do not].)

In **the English Primary 1**, there is a good amount of data to indicate that some of the students were paying attention to ethics and the impact of their ideas. There was evidence across all but one of the categories, with at least 1 rich instances per sub-category that students were demonstrating that they thought about the consequences of their ideas, exploring and actioning new ideas and exhibiting awareness and concern for the impact of new ideas on the group's values. The data indicated that there was evidence across most of the categories but students primarily demonstrated that they thought about the *consequences of their ideas*. In **English Primary 1**, In the March 23rd 2015 pilots the student's awareness of ethics and impact of ideas seemed to lead to more surprising ideas, for example we noticed that: "students showed an understanding of ethical decision making but chose to use some ideas which could be considered unethical in order to get to their ending" and that: "One player decided to kill his dad for money and to help him win". When rating themselves on the creativity wheels on 'exploring new ideas that make a positive difference', most of the young people felt that they were doing this *quite a lot*. Only three students thought they were doing this *a lot* even though this was one of the most evidenced of the WHC categories.

In **English Primary 2**, there was also a good amount of evidence of children attending to ethics and impact of ideas, half of which was generated from rich instances of gameplay, half of which was generated from rich instances of gameplay. In the **Greek Primary School**, there was primarily evidence of students exploring an actioning new ideas, thinking about the consequences of their ideas, creating new associations between ideas and actively explores the consequences of the newly created associations between ideas. Team work and collaboration were primarily the catalyst for attending to ethics and impact of ideas in the Greek primary school.

Exploring and actioning new ideas

Across all three sites there is evidence of students exploring and actioning new ideas through gameplay. In **The English Primary 1** for example, Jimmy, does not worry about the morals of using the 'Tools' card for financial gain when he suggests it to Brian: "The Elder Woman of Water used tools to forge a lottery card" Latcher suggests that committing murder can be an act of love: "you have to kill me because you love me so much" suggesting that love would override morals. "students showed an understanding of ethical decision making but chose to use some ideas which could be considered unethical in order to get to their ending". In **The English Primary 2**, The teacher believed that he saw students exploring and actioning new ideas, both in a general sense "So yes they did think about ethical issues

more through this system, but again it was the higher ability children, they were the ones who spotted these ideas they developed the ideas themselves, in their heads, and saw links. Lower level children, I'm not so sure they would." and in a specific session "Well it was interesting that Jaboscus was saying earlier, with the water shortage, that he wanted to take it from someone, give it to others who were more needy. So certainly he was looking at it as he felt Robin Hood's system, taking from those who've got abundance and giving to those who've got not much. In **Greek Primary School**, students used the card "learn" as a stimuli to create a new idea when students use the meaning of the word and not just the word". On interview the teacher reported, in regards to the history scenario, where gameplay took place, "they felt that they created themselves something new in terms of history lesson and that is interested to them". After gameplay, on interview a student Melopoulos reported: 'The game gave us a chance to use our creativity and the imagination that we needed in order to develop our own stories'

Thinking about the consequences of their ideas

Across all 3 sites, there was evidence of the children thinking about the consequences of their ideas. In **English Primary 1**, one student was thinking deeply about ethics, both inside and outside of the story when he tried to ensure the betrayal between child and parents was resolved. However, in the process added a twist to undo the bits in the story that had caused a little upset between the players, Bob said: "Meanwhile Ginny knew she betrayed her parents so she got a box of treasure from heaven using a ghost body, then turned invisible and gave the box to her parents" The teacher also confirms this one interview, "some students were beginning to think about the consequences of their ideas. They took into account other people's characters and what they wanted to do. I think that very much depended on the innate ability of the children" and "the children themselves wouldn't have worried about impacting on other people" but that: "for some children, they wouldn't want to perceive it as them spoiling another story, if they were a little bit more focused on achieving their ends". In **the English Primary 2**, there is also fairly strong evidence pointing to children thinking about the consequences of ideas. In the May session this seemed to be particularly apparent, where the character in the story assumed power, "They won't be able to kill me, I'm the man of Earth." In the **Greek Primary school**, in the second pilot, within the geography scenario, Sakis Theodoropoulos pointed out that gameplay 'puts me in thought process' and 'It (Gameplay) depends on peoples' imagination', both highlighting that students were thinking about the consequences of their ideas, because without doing so the gameplay would likely be boring.

Understanding different ideas are of different value to the community

In the **English Primary 1**, researchers recognised that all of the students were using death in their stories. Students found different ways to kill off each other's character's in order to ensure their character survived the ending of the game, this was achieved through the introduction of a new evil character, providing some of the existing characters with superpowers and by using the subject of the card as a weapon in some cases. In the **English Primary 2**, students considered water shortages prevalent in a future world. The idea of no

water seems to have sparked concern for the wider community, with the introduction of a community minded outlaw – stealing from the rich to give to the poor noted by Jaboscus, and commented upon by the teacher at the end of the session. “Me and Metal Mario are going to share it, we’re going to steal it from you – I’m going to be like Robin Hood, steal it from the wealthy give it to the poor”. “Well it was interesting that Jaboscus was saying earlier, with the water shortage, that he wanted to take it from someone, to give it to others who were more needy. So certainly he was looking at it as he felt Robin Hood’s system, taking from those who’ve got abundance and giving to those who’ve got not much” A strong sense of morality seems to be in evidence, which was reinforced in another group by Taby “In silence wrote ‘The woman came to and said you did not have to keep the water you just give it to someone that really needs it.’”

Overall the evidence across the three sites showed that the students were thinking about the consequences of ideas whilst attending to ethics and the impact of ideas. There was also a small amount of data which suggested some students were exhibiting awareness and concern of new ideas on the group’s values, exploring and actioning new ideas and creating new associations between ideas. The Greek teacher sums it up this way: “It was nice that children use dilemmas or they got in touch with their cognitive experiences or dilemmas. In this way the imagination expands. The conclusion is not clear because we want more implementation. If we had not the technical problems, maybe I could notice more the substance”. Across all three sites, teachers (and researchers) noted that if there had not been so many technological problems, there would likely be more robust evidence of the students attending the ethics and impact of ideas.

3.1.2 ENGAGING IN DIALOGUE

(Posing questions, debating between ideas, finding ways to negotiate conflict or to go in a different direction to others if conflict not resolved.)

Debating between ideas

Across all 3 sites, there is evidence that there was quite a lot of dialogue taking place during gameplay. In SE1, Following the 23rd February 2015 session the teacher noticed that the students were debating between themselves about the story they had constructed:

“When they came back from working with you,..the conversations that they had had with you, they had continued all the way down the corridor, down to my classroom, and into the cloakroom. So, it had engaged them enough for them to keep going, discussing, and going over what things had happened and what they might change, I do remember that”.

The **English Primary 1** analysis of the rich instances indicated that dialogue was more evident in the second pilot and was predominately used for questioning aspects of the storyline and collaboration. The teacher thought that the students were thinking about collaborating rather than competing, she said: “I think there was an element of ‘a story can’t be competitive’, it can be collaborative in that sense, they can work together”. This was evident when Brian showed his understanding of the opposing elements of the cards, but asked the whole group for approval to use them competitively: “Shouldn’t The Elder Woman

of Water be against The Girl of Fire?”. When rating themselves on the creativity wheels most students thought that they worked on their own and with other people *quite a lot*. In the **Greek Primary School**, students were always active dialoguing during gameplay. The teacher confirmed that one person had a leading role during the procedure but this behavior changed during the second implementation. Students engaged in dialogue in helpful ways as they worked together as a team.

Posing questions with and of others

There was 1 strong rich instance in this category in the **English Primary 2**, and this was the only rich instance across the ‘engaging in dialogue section. When Jaboskus says “I’m the woman off water. We had this argument last time. To be ‘of’ something means to be made of it.” [Long dialogues, involving the researcher and Sambot.] “It doesn’t mean their spiritual form dies as well” he is posing questions of his group, and suggesting that this is not the first time these issues have been discussed. He also attempts to draw the researcher into the conversation, widening the dialogue beyond his play group.

Overall across all three sites, the evidence suggests that dialogue was mostly used for debating ideas

3.1.3 BEING IN CONTROL

(Taking charge of parts of the creative process [understanding rules of the system, decisions have consequences, making decisions, taking action].)

In the **English Primary 1**, there is evidence that students were using different techniques to take control. This category was the *most evidenced* through actual game play. There were also instances of students trying to take ownership of and change the story when they didn’t approve of it. An example of this is when one student eliminates the character that had killed other characters off: “Using the symbol that was in the magic unicorn hoof she brought everyone back to life, but the rabid man Paul died and was never able to be brought back to life”. One student recognised how going last would enable him to change the story at the end towards his direction: “I hope I get the last card, and then I am able to change it.” Players also used teamwork to control the direction of the story as some of the players teamed up against Brian to destroy his evil character. This is recognised by Brian and he then realises the importance of teamwork in the construction of the story when he says: “Are you on my side? Which team are you on?”

In regards to the **Greek Primary school**, students completely understood the rules of 4scribes game (basic version). During the second implementation, they played without any help except when students could not use some cards. Students did not remain calm waiting for their term. This was a major problem. In terms of their decisions, students could not always control their opinion due to unexpected cards. The teacher pointed out: “During the second implementation I do not think that they understand completely that this was the nut, the notion of creativity or the creativity through the upset. They integrated easily to the notion of playing games to create something together through playing. They like it and it was easy”

In **SW1**, there was *considerable* evidence of 'being in control'. They are dealt with separately below:

Taking charge of different parts of the creative process: The teacher identified that there were particular children who were more likely to 'lead'. "This group, there was a very strong character in there and she was leading the pack a lot more". The teacher also believed that the children were unused to having the power to change their roles. "it's not for you to adapt that character, that character is what it says on the card, and that doesn't change." A strong theme that seemed to emerge was one of teacher control, but the evidence gives an interesting contradiction between what the teacher **said he had done** overall "I've taken a very back seat during C2Learn and given them all the autonomy to completely control their game" and what he actually did "So everything is teacher led, and that's fine, but a question mark icon in the top corner would help." There was also suggestion from the teacher that the app was exerting a level of control over the storymaking, *inhibiting* the children's creativity by imposing spelling and grammar rules, "because it's their own story they should be dictating punctuation not being prompted, and also spelling mistakes, if they're made, they shouldn't be too hung up on them," "Some of them were getting frustrated at actually a lot of things they were writing were being underlined, that was a bit demotivating. Whereas if we completely cut that out of the app, they could write without that stigma, or thinking 'oh not only am I struggling with writing a story, in a given time limit, in a given word limit, with a card I'm not sure what it is, but also my spelling's not right, my punctuation is a bit sloppy'"

Understanding the rules and that they have consequences: The teacher noticed discussion between the children about what could and could not happen, "A lot of refreshing their memories as to what can and can't be included in the story, and there was a lot of rebuttals. Like people saying you can't include that that's not... they were looking at continuity much more in the story." as well as some attempts to re-engineer the rules to meet their own ends. "I think they understand them enough that they want to play just within them, some of the children; they want to stretch them a little bit." The inbuilt unfairness of the voting system was cause for concern early in this pilot, with children noticing that the order of play impacts on the success or failure of the endings. "The system is not fair because the last person to add their paragraph gets to lean the story towards their ending more than the first person."

Makes decisions and takes action: One player seems to have decided to ensure that his will is not thwarted in the future, "I'm trying to get rid of every single loophole" He has been angry when another player successfully contradicted his killing of their character. The teacher went on to suggest some external reasons for a lack of decisiveness in play, suggesting that a short timespan in which to play would inhibit action: "Some that were finding it difficult to actually make a decision of what happens in the story within the timespan given." In addition, the teacher stated children are not used to being given autonomy to be decisive. "They're not used to being given the freedom to actually change something which is there on screen, and looks it set in stone. That character is the woman of water and they want to change it or they might shorten it to an acronym or something like that"

Overall, across all three settings analysis of the data suggested that the main element of control was evidenced through taking charge of the story in order to get to the student's ending or to undo previous parts of the story. There was also a small amount of data to suggest that some students were mainly making decisions and taking action when they wanted to change (control) the perspective of the story. The **English Primary 2** data provided the largest count of evidence overall and there appears to be some evidence that the children were enabled to be decisive, regardless of ability, and the methods they employed seem to evidence a level of confidence, which transcends gameplay ability. The Greek data confirms this, "I think if they played more, they would have started to see those links a little bit more clearly. Their ability to manipulate the events to their own conclusion, I think that would have got better with experience"(T)

3.1.4 ENGAGED ACTION

(Being immersed in the experience. Being addicted, not able to stop, trying repeatedly. Such immersion sometimes leads to taking risks.)

The **English Primary 1 and 2 and Greek Primary** data indicates there was quite a lot of engaged action taking place during both pilots. There was evidence recorded across all of the categories in the English Primary 1 and 2, but students were mostly showing *immersion*. This was evidenced through teacher and researcher observations rather than the rich instances of gameplay. In regards to immersion: "Students were engaged throughout and ensured the story flowed from one to another"; "Players were engaged with the gameplay during their turns but were a little distracted when it was not their go"; "I was quite surprised that once they had played the game, how enthusiastic and engaged they must have been to come back into the classroom being really buzzy about it".

In regards to coming up with surprising ideas: one student, who was not taking the game seriously at the beginning, came up with the most surprising twist to the story of the group: "Jimmy was writing a book by candlelight, as the woman of water fell the candle flickered – when she hit the ground the candle went out – he was left in darkness" and when another student suggested that "you have to kill me because you love me so much" In English Primary 2, This area was the most evenly rated on the creativity wheels, with 5 'a lot' 5 'quite a bit' and 6 'a bit'. Evidence also comes from a rich instance, but it is from a part of gameplay which occurred after the digital tool failed, and the children were playing on paper. ChiChi invented a card for her turn, saying that she had forgotten her original cards. The card she invented, whilst following the format of 4Scribes, i.e. a baby, was particularly useful to her in achieving her secret ending. "Baking Baby – I made them up"

Taking risks: Most of the students rated themselves on getting engaged in C2Learn and taking risks on the creativity wheels as *quite a lot*. However there were more students rating themselves as a lot than on any of the other categories, possibly showing that they enjoyed playing the game. It is also interesting how one student from the group who did both pilots rated herself as a bit on the first pilot and as a lot in the second pilot, demonstrating that she thought she was more engaged with C2Learn over time. Evidence highlights students were engaged in the C2Learn experience whilst playing and after playing the game. "Students

were engaged throughout and ensured the story flowed from one to another.” and that at times the engagement occurred during their turn but less so when it wasn’t. In the 23rd March 2015 pilots immersion was observed again but this time the students became more engaged as the story developed: “Students were more engaged when trying to direct the story towards their endings.” The **Greek** teacher highlights how students attempted to take risks “they tried to present something new even if there had some difficulties but they surpassed. I do not know how it influenced the plot of the story if this brought out from a context they were but I think they can control it if they had some cards, these cards were few”.

In **English Primary 2** data also indicates there was quite a lot of engaged action taking place during both pilots. Immersion in and does parts of the game/ activities addictively: There was some evidence from gameplay of immersion, both in the children’s behavior, and also their conversation outside of their turn. A verbal outburst from two players, plushy friend and metal Mario “Ay Ay Ay” seems to have been linked to forging alliances within the story, with a view to reaching their ends, and isolating another player, Sambot. They appear to be immersed in the story outside of their turns. The teacher did not feel that the children were immersed in the games, “Stories did not keep children entertained between their turns “because their imaginations were really engaged when they were doing stuff, but when they weren’t involved their minds were wandering to other things and then they were losing interest towards the end.” In the plenary session much earlier in the pilot, he expressed the same belief “Children not using the App have to wait a long time before taking their turn and have nothing to occupy them. The teacher admits however that the children are keen to take part in the C2Learn activities “but when I’ve said that we’re doing C2Learn they have been engaged. They’ve wanted to do it.”

Taking risks and leave his/her comfort zone: On two occasions in different game sessions, it appeared that the children did not understand the word on their cards. Instead of stopping, or asking for help, these children played on. This seems to be a brave move for such young children. The teacher agreed that this behaviour seems to suggest an element of risk taking “Some were taking risks by using the cards because the card was quite complex and I had an idea that they only has a vague grasp of what it was suggesting.”

Facilitates immersion in the gaming experience for the rest of the group: Much of the evidence focuses on group working, with children joining forces in the stories, or interacting together outside of their turn. The teacher notes that the children are desperate to tell their secret endings, but questions the extent of the teamwork element. One student suggested that the story, and in particular the way the story moves, is engaging. “The story swirls around which makes it good”. He seems to be suggesting that the nature of the storytelling itself promotes immersion. In the same session one child did not feel that the gameplay was really schoolwork. This could indicate that the child enjoyed gameplay so much that it was not in fact viewed as work. “I’m not sure because it’s not really work. It’s probably something you could use at home for fun, but in schools it’s not really what you would call a teamwork game.”

Overall across all three pilot sites, the main element of engaged action that was evidenced was immersion and wanting to play the game. This was observed mostly by teachers and researchers but was demonstrated in gameplay and wanting to continue gameplay. There was disengagement when the students were in-between turns.

3.1.5 INTERVENTION AND REFRAMING

(Specific changes in thinking patterns, and in particular reasoning processes. Changes in expression, primarily in linguistic terms, but also encompassing other modes as well.)

In **English Primary 1**, evidence of intervention and reframing to create new perspectives and new connections was observed in most of the sessions. For example Bobby Junior said: “Can I say who the person talking is?” as he wanted to change the perspective of the narrative and Brian asked: “Shouldn’t The Elder Woman of Water be against the Girl of Fire?” in order to try to change the collaborative story into a conflicting one. A new connection was suggested by Lara when she advised another player to respond to: “was she going to go left or was she going to go right? But The Woman of Wind swept her up with the wind” and Julie brings all elements of the story together through the suggestion that the wind is instrumental in making the circus go ‘crazy’ when she added: “and there was loads of wind on the island...and that’s why the circus is going crazy”, thus creating new connections and perspective of the story at once. These examples suggest that the intervention and reframing tended to happen when cooperation was occurring in the story.

In **English Primary 2** there was more evidence of Intervention and reframing than in **English Primary 1**, Using stimuli in creative activity was evidenced when a child seeing the character on the card in a more personalised way, as the ‘wind grandma’ rather than the old woman of wind’ “The woman of fire joins up with the wind grandma and tries to destroy everyone who opposes them” to the boy who ignored the word on his card, and gained his inspiration from the image instead. “The farmer got magical powers from dodo whispering” The student used the image on the card in place of the word. The authoring of the co-creative story itself seemed to stimulate imaginative thought processes. The teacher seems to view the stimulus in a more pragmatic fashion, as a means to an end “definitely that system of writing scaffolds how to write a story, and the assisting with cards does help them when they get stuck or they don’t know what to do” “That gives them that springboard into actually writing the story.” The plenary session on the 11th May seems to largely support the teacher’s thoughts, that this game could be a tool to stimulate the imagination. “Sometimes, it depends on the context. If you have to write a story in class then you have no idea sometimes what to write. This game helps because you get a card and if the card is relevant then it starts your imagination working more.”

Using stimuli to create new connections between ideas: One boy, in discussion with the researcher was testing out the possibilities for his creativity. He seems to want to check how far his imagination could go “So you could have something like tomato, but then if you saw the link to something like a gemstone, you could use gemstone” Another student’s comment “However, if people have good imaginations then the story can go crazy easily, but then it can turn out really good.” seems to also be revelling in the creative possibilities, when new

'crazy' connections are made. Using stimuli to help develop a new perspective of the challenge: At the first research visit Jaboscus responds "The past is past" to a comment from Sambot regarding the finality of death, at the second research visit, he was again responding to Sambot, and refers back to another game play session, suggesting that they have had ongoing debate. The crux of the matter was again Sambot attempting to kill Jaboscus' character, and Jaboscus using philosophical thought to counter the death. "I'm the woman off water. We had this argument last time. To be 'of' something means to be made of it." Long dialogues, involving the researcher and Sambot. "It doesn't mean their spiritual form dies as well". Jaboscus first seems to limit the impact of time on his current situation, and then seems to become quite spiritual when discussing the survival of his character, the woman of water. It may be that the student's comment is correct in limiting the craziness of the stories to the imaginations of the players. "However, if people have good imaginations then the story can go crazy easily, but then it can turn out really good."

In the **Greek Primary School**, there is limited evidence of intervention and reframing, but the students did believe they were using the stimulus *a lot or quite a lot* to think in new ways. .

Overall the evidence suggests that the English students were creating connections between ideas, developing new perspectives and sometimes going beyond the material provided by the challenge. The evidence also suggests that the English students, and to some extent the Greek students, were creating connections between ideas, developing new perspectives and sometimes going beyond the material provided by the challenge though gameplay.

3.1.6 4Ps

(Evidence of high participation [engagement and involvement], high pluralities [taking on many roles, personae, perspectives], high playfulness [operating in an as if and playful manner] and high possibilities [generating many ideas through what if and as if thinking].)

In the **English Primary 1** and the **Greek Primary School**, data identified in the rich instances demonstrated high participation or high possibilities which suggests that there were times where students were experiencing engagement, being involved in the process and were sometimes thinking about the possibilities of the game. There was a small amount of evidence to suggest some of the students were using pluralities and playfulness to help with the construction of their story. Greek students commented: 'We could all express our opinions' and I liked that every child could freely express his/her opinion about each story'.

High pluralities were identified in the rich instances. There were two ways that these were used in **English Primary 1**, the first was to provide a new perspective, for example Jim-Bob Dingleberry showed an understanding of his parent's perspective whilst maintaining his own morals: "Next on was the animals which I didn't like. Mum and Dad worked here – they would be angry if I caused an outburst. I ran into the ring and tried to stop it. It was cruel that these animals were being used." and when Jimmy changed the perspective of the story when he brought all of the previous ideas together to help create the new perspective: "Jimmy was writing a book by candlelight, as the woman of water fell the candle flickered – when she hit the ground the candle went out – he was left in darkness" Another example of

the use of pluralities was when the whole group took on a new personae. This occurred when Dermatologist used a strange accent when he said “the elder woman of water”, which the rest of the group then adopted.

In the English Primary 2, the evidence for 4 Ps was spread across the categories, with 6 rich instances of possibilities 5 of pluralities, 4 of participation and 2 Playfulness. This suggests that on many occasions children were generating possibilities, as well as taking on many roles, personae and perspectives. There is limited evidence of engagement and evidence of playfulness. At the first research visit all four children marked themselves highly for possibility, but were divided as to whether they had participated, Plushy friend and Sambot marking high participation, while Metal Mario and Jaboscus marked themselves very low on this scale. The rich instances would suggest that Sambot has correctly rated himself, as he has contributed two rich instances in the participation category, whereas Plushy friend has none. Jaboscus has contributed the only two examples of generating possibilities in that session.

Overall, the data illustrates students believed they were experiencing high participation and possibilities during game play however, the data from the axes and wheels showed that the students were not always recognising this. Evidence showed the use of pluralities during game play when the students were thinking of others, bringing in previous characters and storylines and using different accents.

3.1.7 UNDERTAKING A JOURNEY OF BECOMING

(Over time, noticeable changes in participants’ dispositions and/or personalities. This may involve smaller incremental changes.)

In the **English Primary 1**, overall there was very little evidence of changes in student behaviour over time. Researchers saw small amounts with the groups who were present for both pilots, there was not any clear evidence from the students and the teacher didn’t recognise any in these pilots but thought there may have been if the pilots were digital. In **English Primary 2** and the **Greek Primary School**, there was a small amount of evidence to suggest that there were changes to children’s behaviour over time, but that this was not a JOB.

3.1.8 GENERATING QUIET REVOLUTIONS

(Over time more noticeable changes in the creative community stemming from creative ideas generated; might comprise smaller incremental changes.)

Across all three pilot sites, there was no evidence of generating quiet revolutions. However, this was to be expected given that quiet revolutions are anticipated to take place over extended periods of activity, which was not the nature of these pilots

3.1.9 PEDAGOGIC STRATEGIES

(Evidence teachers proactively valuing learners' ideas and actions; enabling learners to take the initiative; ensuring sufficient space and time for ideas and actions to emerge getting alongside the learner and learning as fellow collaborator.)

In the English Primary 1, evidence showed that C2Learn made the teacher make the students more aware of what they were doing through discussion of the wheel categories. The teacher thought this led to increased talking in class. The teacher also thought that C2Learn made her more explicit and focused on what she was doing in class and the data showed that she had started to think about different scenarios she could use in the game especially to help the students with resolution. "Had I not been involved with C2Learn, I don't think I'd be as explicit as I was, so I think it helped me to focus on that a little bit more." There was also evidence of the teacher thinking about ideas of how to use C2Learn in the classroom in the future: "and I was thinking today about stories that they could create you know based around somebody who was either being healthy or unhealthy... so I do think it would require a little bit more thought going into it, but I think you could build on other scenarios within that."

In English Primary 2, The teacher stated that the C2Learn model was how he would like to teach. He stated that he had taken a "back seat during the C2Learn pilot". However his control was evident both in his interview "So everything is teacher led, and that's fine," and in the field notes "Halfway through play – the other half of the class returned from outdoor play, and were instructed to read quietly. This meant that the teacher *renewed* focus on silence – so as not to disturb the readers." It appears that the teacher believed he was teaching during the C2Learn project in a more relaxed way, but in fact he seems to have been exerting a level of control over space, dialogue and volume, and student activity.

In the Greek Primary School, the teachers noted the Socratic Dialogues gave them a chance to understand children's opinion about their role across gameplay. "I think in everything there maintain a measure. It is a positive tool as we can see in this moment but this could not be repeated so often. This is my opinion. We should test it sometimes during the school season. All the others should connect with other activities with the lesson." and "As we say C2learn, it is the meaning of creativity. I think that we already work with creativity's axe. I cannot say that this (C2learn) rebut the teaching. Our goal is to foster creativity. So, every teaching which corresponds to creativity is legitimate".

Question 1 Summaries for main categories

Therefore, overall across the three sites, the evidence showed that the European 10 to 12 year old students were thinking about the ethical impact of their new ideas, and were exploring and actioning ideas. There was evidence of them engaging in dialogue in England and less evidence of this in Greece. There was a data across the three primary sites of the students being in control in different ways, and of being engaged in action (gameplay and co-creating the stories) in the games in order to generate surprising ideas and take risks through immersion. There was a data from the English sites to suggest students were using intervention and reframing in the gaming experience, and were aware of how it functioned,

yet this was not necessarily the case in Greece. Overall across the 5 co-creativity categories, it is therefore possible to say that the primary students evidenced some co-creativity when they were engaging with C2Learn tools and environments. Out of the 4Ps, participation and possibilities were the most evidenced across the three sites; there was limited evidence of pluralities in England and little evidence of playfulness as well when a student noted how the game was more fun than work. Perhaps to be anticipated, there was little evidence of journeys of becoming or quiet revolutions because of the curtailed length of the pilots and continuous failure of the C2Space on the tablets.

2. How does manifesting of co-creativity (WHC and CER) in C²Learn change over time?

Assessment of students' *lived-experience* in terms of co-creativity along the WHC dimension.

In both of the English primaries, there is some evidence of change over time. In the **English Primary 1**, the rich instances data showed most of the students thought that they tried out new ideas and different ways of doing things either the same or less in the second pilot than they did in the first. They also thought that they would think about what might happen because of their ideas either less or the same in the second pilot. In contrast, however, most of the students thought they could decide which ideas were valuable to the community more in the second pilots showing an increase in the ratings in the second pilots. In regards to engaged action, there was a noticeable change in the rating over time with one student in this category. Magnificent Swimmer rated getting addicted to the game and taking herself out of her comfort zone a bit in the first pilots and a lot in the second. She also thought that she came up with ideas that surprised others quite a lot in the first pilots but a lot in the second pilots.

In the **English Primary 2**, at the second research visit, small changes were noticed. From the first research visit, although the students have reduced their self-assessment by this time. At the first research visit only *thinking about the consequences of ideas* generated rich instances, whereas the second visit generated rich instances of *Understanding different ideas are of different value to the community* and *Actively explores the consequences of the newly created associations between ideas*. With the creativity wheel, some small changes were evident, with players reducing their ranking for *poses questions with and of others*, but *increasing negotiates conflict or goes in a different direction*. In regards to the **4Ps**, at the first research visit all four children marked themselves highly for possibility, but were divided as to whether they had participated, Plushy friend and Sambot marking high participation, while Metal Mario and Jaboscus marked themselves very low on this scale. The rich instances would suggest that Sambot has correctly rated himself, as he has contributed two rich instances in the participation category, whereas Plushy friend has none. Jaboscus has contributed the only two examples of generating possibilities in that session. After the second visit all four had moved their assessment to high for both participation and possibility. The rich instances show that these four children contributed many instances of **4Ps**.

In regards to a **journey of becoming**, there was a small amount of evidence in the **English Primary 2**, to suggest that there were changes to children's behaviour over time. The teacher noted that to begin with the children played in friendship groups but that there was

also a will to work with children of a similar ability level “they kind of sought each other out “. He believed that with more sessions the ability groupings would become the norm “we’d have one group which was very high level, very competitive and everyone’s arguing, one group which is kind of midlevel and everyone’s actually working very well together and being quite humble about each other’s ideas, and then a lower group who potentially need a lot of assistance to actually get them to work as a group” “So I think they would separate, given the opportunity and given enough practice, into those sort of categories.”

It is possible that there was a slight change in the behaviour of Sambot over the piloting period. During the first research visit he was highly vocal, and contributed 3 of the 5 rich instances, however in the second research visit he contributed no rich instances. On one occasion he was seen to be playing a clapping game with a friend in another group, and he also isolated himself, saying ‘go away’ and pushing plushy friend away. He seems to have moved from being a controlling member of the group to an outsider. Comparing the children’s axes, shows that Plushy friend and Sambot did not think their possibility or participation had changed over time, but both Metal Mario and Jaboscus moved from negative participation to strongly positive participation. The rich instances do not support this self-assessment.

In the **Greek Primary**, despite the fact that students expressed their huge interest about the games, they did not seriously change their thinking patterns. Deeper engagement and more implementations are needed so as to form a conclusion.

3. What role is played by C²Learn technological tools and corresponding pedagogical interventions, focusing in particular on students’ experience?

In the **English Primary 1**, the pilot was conducted with paper versions of the 4scribes game. It was evident that both the teacher and student were disappointed by the lack of digital tools. Analysis of all of the data demonstrated that aspects of the WHC features were displayed through the use of the cards despite the teacher’s dislike of them. The teacher thought that the images on the cards were sometimes hard for the students to understand and reframe, she said: “The pictures on the cards often threw them”. However, the rich instances data showed that there was a fair amount of reframing occurring throughout the games and that there were two instances of students who used the images very creatively to go beyond what was presented before them. For example used the ‘book’ image to suggest that the death of the previous character had an effect on the whole environment: “Jimmy was writing a book by candlelight, as the woman of water fell the candle flickered – when she hit the ground the candle went out – he was left in darkness”. Another student, One Direction Lover used her girl of earth image to make connections to the circus: “But the amazing girl of earth (lily) made a brilliant new tent, for doing the circus with the animals, out of trees”

In **English Primary 2**, the piloting activity was extremely badly affected by technological problems. The start was delayed as the apps could not download. This was followed by difficulties in logging on – the children found the passwords extremely difficult to navigate. Week 1 of the pilot was largely devoted to logging in and familiarizing the children with the apps.

4. Development and refinement of C²Learn's Assessment Methodology tools with particular focus on:

[a] Tailoring of categories to C²Learn's game(s)/gaming environment.

None recorded

[b] Developing the Socratic Method type interview protocol in relation to C²Learn's game(s)/gaming environment.

None recorded

[c] Specifying the Computational Creativity metrics to be used.

None recorded

[d] Refining the rest of the evaluation tools in relation to C²Learn's game(s)/gaming environment.

None recorded, but a clearer explanation of the connections of the categories on the wheels to how they relate to participation and possibility thinking may be helpful. The creativity wheel segment which has the scale – a lot, quite a bit and a bit, is often left blank by children, in this pilot this was identified several times, and the wheels passed back to the child, unfortunately this was missed once by the researcher in this pilot, so data is incomplete.

4. UK AND AUSTRIAN PILOT (M30-M36 CYCLES) ANALYSIS SYNTHESIS

This section synthesises the common analytic outcomes, as well as the differences, in response to the C²Learn Research Questions, based on formal analyses of the UK and Austria data, from the M30 and M36 Pilot Cycle (Secondary School).

	English secondary 1	English secondary 2	Austrian secondary
Contextual information	Game play across 2 x 20 minute sessions with different 17- 19 year olds each time, using paper prototypes. February 24th 2015 research visit worked with 1 group of 4 students (2 male + 2 female) (whilst 3 other groups also played). No gameplay between research visits. March 24 th 2015 research visit worked with 9 students (4 male + 5 female) (in pairs and 3s). In both, students were given an ethical dilemma and used 4Scribes game.	Game play across 3 sessions with the same 5 x 15-16 year old (male) students using digital tools (Creative Stories and Explore and Expand). The sessions ran for an hour at a time on 2 nd , 3 rd , and 7 th July 2015. Game challenges used for story construction in Creative Stories standalone app (2 nd + 3 rd July). Explore and Expand standalone app used (7 th July).	1 x week long project (24 th - 30 th June, 6 hours per day). 2 researchers and 2 teachers worked with 12 students (three male, nine female 16-18 year olds). On 1 st day and last day participants played 4Scribes; other days Iconoscope, Creative Stories and various creative learning activities (dancing workshop, acting workshop) took place.
Data collection	1 teacher interview after session 2. No axes or wheels after session 1; 9 student axes and wheels after session 2. Film and audio footage from sessions 1 and 2.	No teacher interview. 5 student axes and wheels after 3 rd July 2015 session; and audio footage was recorded from all sessions. No filming as students not given consent.	1 teacher interview on 1 st day; 1 teacher interview on last day. 2 student interviews on 1 st day, and on last day. 2 Group SDs (1 PRE, 1 POST). Fieldnotes from 2 teachers + 2 researchers. Film from gameplay.
Data processing	Researcher who collected data, carried out 1st low level analysis, starting with rich instances in film footage or audio, followed by axes and wheels, then teacher interview, where they existed. Then senior member of research team read and commented on credibility of analysis as means of triangulation. Original researcher made any necessary changes to the analysis following discussion. In English secondary 1 there were 23 rich instances identified from film analysis and in English secondary 2 there were 26 rich instances identified from audio analysis.		Teacher and student interviews analyzed by researcher 1 and 2 with rich instances viewed and integrated with interview analysis. Researcher 1 verified researcher 2's film footage and interview analysis

Table 2: Methodological information for UK and Austrian Secondary School analysis

4.1 SYNTHESIZED COMMENTS ON CO-CREATIVITY

Despite the English pilots being very short, with no game play in between and some of the data collection methods not being used, there is useful English secondary data. This has been synthesized together below with the Austrian data from their one-week secondary intensive to respond to the 4 research questions.

1. How do participants manifest co-creativity (WHC and CER) through C²Learn gameplay?

Question 1 analysis uses the Co-creativity categorization framework as a structure.

4.1.1 ETHICS AND IMPACT OF IDEAS

(Generating, exploring and enacting new ideas with valuable community impact [discarding other ideas that do not].)

In English secondary 1, there was a small amount of data to indicate that some of the students were paying attention to the ethics and the impact of their ideas. There was evidence across all but three of the categories, within at least 2 rich instances per sub-category that students were demonstrating that they thought about the consequences of their ideas, exploring and actioning new ideas and exhibiting awareness and concern for the impact of new ideas on the group's values. The data showed that overall this was one of the most evidenced of the WHC categories and that the evidence mainly came from rich instances of film analysis supported by a teacher interview and field note quote. For example the teacher commented on the students' ethical debates, during a provocative storyline: "Some students were given a lovers card and they were suggesting that perhaps the rapist and the victim ended up becoming lovers and partners", "That was quite a challenging idea", "It therefore suggested to some of them that the victim wasn't really a victim of a crime and so she must have consented".

In English secondary 2, there was a small amount of evidence in the rich instances of the audio data to suggest that one student was exploring new ideas once he understood the meaning of a new word. For example the rich audio instances analysis showed that the student found out what the word he added meant and then used it in the context of his own emotions. Ali said "Sometimes I feel like trapping off from this school". Later the same student uses the accumulation of his own ideas to create a more creative entry, once he had learned what the word 'shroud' meant.

In English secondary 1, although the challenges in both sessions had strong ethical themes (the construction of the life of Ahmed through different class systems in the February 24th Pilot and the issue of rape in the 24th March pilot) which ensured the students were addressing ethics, there were some elements identified which were prompted by the theme of the cards. For example, Green used the Miracle card to think about the moral issues affecting the rapist and in a surprising twist he brought back the man to look after her and the baby. "It was a miracle the man who impregnated her returned to look after her".

In English secondary 2, a small amount of evidence in the rich audio instances analysis showed students thinking about the consequences of their ideas in different ways, for example two students actively toned down their suggestions for the story entry which was originally mocking another student: Dave said “A man called [students real name] had a rash on his face because he sat under a medicine cabinet and the medicine went all over him”. In this case Dave was talking about the other student’s spots on his face but changed it to say the rash occurred because of medicine. This was interesting because in all of the sessions there was a lot of conflict occurring, as noticed by the researcher in their field notes: “Students also used the ‘in-between turn’ times for insulting each other”, but that it often fed in to the story construction: “Students were again using banter and mocking each other as part of the game strategy and story construction”.

Overall in English secondary 2 on the wheels, the students rated themselves as quite a lot or a lot for exploring new ideas and making a positive difference. It is interesting that the student who rated himself as doing this a lot was only heard providing one rich instance in the audio data. This suggests that he felt he was contributing but was either providing ideas for others to use or was not speaking loud enough to be heard.

In the Austria secondary data, there were a few experiences relating to ethics and impact. The students chose to write a story about the way humankind treats the environment. Their discussion demonstrated that it was extremely important for them to generate a storyline about destruction but also about injustice and prejudices against people who are different or want to fight the system: “Andrew: Maybe we should write that politics and humans become more radical, exclude everyone and the artists want to do something against it.” “Francine: Because he is active. He is an activist.” “Lulu: Which is why they show that in their paintings and paint it. Francine: Exactly”. The students thought about the ethical questions that may arise in society when people try to fight for something.

However, during the Austrian Socratic dialogue, the students explained that they wanted their story to end in a particular way to take a firm stand against the way mankind treats the environment: “I think the end is the most important part. That the tree dies and has been destroyed by humans.” For the students this meant “Destruction due to progress” and was supposed to express “That humans are corrosive.” One student even mentioned that the ending that they chose together was particularly important to her in order for the story to have an impact on society and on the community. She said: “I really believe that an intense ending can have more impact.”

Regarding the creation of new associations between ideas, in the Socratic Dialogues the students admitted that it was quite difficult to incorporate the various concepts they wanted to use in a meaningful way: “We had difficulties with the cards with humans. And had to find a connection to the people, the politics and how people were feeling at that time. That was not easy.” However, the students managed to come up with interesting solutions to use specific cards in a new, imaginative way (see ‘**Engaged action**’)

Overall across the three sites, the evidence showed that the European 15 to 19 year old students were thinking about the consequences of their ideas, e.g. when they used the story to tone down the previous mocking of another student, and the environment/humankind

conflict. In all three sites, the analysis showed that some students were exploring and actioning ideas e.g. when a new meaning of a word was discovered; thinking about the consequences of them and exhibiting awareness and concern of the impact of new ideas on the group's values (also supported by teacher interview data), and wider society.

4.1.2 ENGAGING IN DIALOGUE

(Posing questions, debating between ideas, finding ways to negotiate conflict or to go in a different direction to others if conflict not resolved.)

In English secondary 1, there was a very small amount of data to suggest students were engaging in dialogue during both pilots. There was a similar amount of evidence across all of the categories, taken from a different source for each category. The teacher interview analysis evidenced students were being thoughtful, respectful and reflective, rather than openly conflicting: "they were respecting each other's ideas and opinions, they seemed to be thinking more, reflecting more perhaps". The field notes showed that students were debating between ideas, although sometimes to the detriment of game progress: "...groups were debating ideas throughout the entire session and hardly got started on the game". The film rich instances showed that some students were posing questions of each other. For example Berry questioned the colour of the baby in order to help him determine how he directed the decisions of the religious man: "What colour was the baby?".

In English secondary 2, evidence showed that there was quite a lot of dialogue taking place in all pilots. Data showed that there was evidence across all of the categories, but mainly from debating between ideas and negotiating conflict. Evidence was mostly taken from the film rich instances. For example: on 2nd July 2015 students question Bob about why he used a word he didn't know the meaning of, he said "He asked me to put it so I put the sentence in the story". This demonstrates the use of suggestions through the debating of ideas. Later, on 7th July 2015, Ali found out what 'trapping' meant through the debating of ideas about the word between students and teacher. He then used it in the context of his own emotions, he said "Sometimes I feel like trapping off from this school". There was also some evidence from field notes that the students were debating between ideas within all sessions "...discussion took place between a few of the students" and "all students took part in the discussion of the story". The field note data also recognised that conflict was a driver for game play: "Banter is used as very much part of the game play. Making conflict the main source of content of the theme".

From the wheels in English secondary 2, the students rated themselves as working on their own and with others quite a lot or a lot. For example, Ali rated himself a lot and was the most vocal throughout all of the sessions, however, James was whispering throughout the sessions and also rated himself as working on his own and with others a lot. Again, this could suggest he was taking part even though his ideas were not recorded on the rich data analysis of the audio.

In the Austrian secondary, there were a lot of examples of engaging in dialogue. This was particularly obvious in film rich instances: Andrew: "Okay. We have to come up with an end.

Maybe the forest is being destroyed by a tornado.” Annette: “The forest was cut down.” Francine: “No, that’s too apocalyptic”. Andrew: “Yes, that’s true.” This is a good example of all the students debating in the discussion between different ideas about how to go on with the story as well as dialoguing to think about the ideas’ consequences, and come to a collaborative end. Talking about this process, students said that they were able to negotiate conflict by discussing everyone’s ideas and trying to come up with a storyline everyone could agree on: “‘The ideas were coming from everyone.’ (Francine). “There were disagreements, but then you talk about it and agree on something, which is what we did.” (Andrew). The head teacher confirmed that students sometimes had strong debates, but also pointed out that they listened and respected opinions. ‘They listened to each other. They might not have let each other finish all the time, but every student was able to convey his or her ideas without getting cut off.’ (Headteacher).

Overall there was some data in England and a lot of examples in Austria that students were dialoguing and that they were doing this via debating, negotiating conflict and posing questions.

4.1.3 BEING IN CONTROL

(Taking charge of parts of the creative process [understanding rules of the system, decisions have consequences, making decisions, taking action].)

The English secondary 1 data showed a very small amount of evidence in this category. All of the sub-categories contained some evidence but overall the evidence only came from one field note quote, one film rich instance and four teacher interview quotes. The field notes identified one student using control to put a stop to the direction of the story “One student wanted to eliminate the dilemma by killing off all involved apart from the innocent baby”—and a student trying to control the story to his ending. The interview analysis showed the teacher allowing this to happen: “and I kind of let them run with it a bit because I wanted to see how they got on”.

In English secondary 2, there was evidence across all sub-categories in this category. All of the evidence that students were taking charge of the creative process, understanding the rules and consequences came from field notes, which perhaps makes it less strong than evidence directly from rich instances. Most of the control seemed to occur when the student was either typing or making word suggestions, or story construction, for example on 2nd July 2015 pilot “one player took control to type. One other took control of the words which were being added”. All of the evidence of students making decisions and taking action was taken from rich instances of audio data. On 3rd July 2015 pilot it was noted that the student who was in charge of typing did not want to give the control of it to the teacher, and on 7th July 2015 field notes data showed that student seeming to want to take control more “One student took control of the typing and what words were added. This student sometimes refused to put in suggestions from one particular student who had good ideas”. However, evidence also shows this same student giving the control to others during the session “This student also started to include others more by asking them to contribute individually, thus letting go of the control of the direction of the game”.

On the wheels in English secondary 2, most of the students rated themselves as being in control quite a lot even though the rich instance analysis identified only two students who dominated sessions with their ideas. Again the student who was whispering rated himself as being in control a lot even though there was no evidence of this in the rich instances. This may suggest that this student thought he was in control by whispering ideas to other students.

In Austria, a strong group dynamic could be seen in nearly all gameplay activity as well as various other learning activities, with girls and boys leading at different times. The Headteacher noted that “Each group had its alpha animal, except for one group where there was not a lot of progress anyway. But aside from that, yes...This was pretty obvious especially with the girls, who had the class leaders, the group leaders, who set the tone.” And the field notes indicated: “There is an obvious leader in the group with the boys.” Headteacher and student quotes showed that there were no issues with understanding the rules of the games.

Across the three secondary sites, overall there was a small amount of data to suggest that students were taking control. English secondary 1 showed students taking charge of the different parts of the creative process, and English secondary 2 saw students taking control via typing and whose storylines they chose to include that way. In Austria, data showed different students successfully leading at different times.

4.1.4 ENGAGED ACTION

(Being immersed in the experience. Being addicted, not able to stop, trying repeatedly. Such immersion sometimes leads to taking risks.)

In English secondary 1, there was a small amount of data which suggested students were being immersed in the gaming experience. Only two of the categories were evidenced in the data. Field note observations identified students as being quite engaged: “Players were engaged with the gameplay during their turns and showed a good understanding of the storyline and the situation. They also thought about their roles and applied them to the story”. Rich film instances showed one of the students in the first pilot sometimes coming up with surprising ideas. For example, following a storyline which raised moral questions involving a baby’s birth, Green demonstrated interesting ideas when he finally gave power to the innocent baby to eliminate everyone ““The baby came and blew them all up”. A teacher interview quote reinforced this: “they seemed to be thinking more, reflecting more perhaps”.

In English secondary 2, there was a very small amount of evidence across three of the four categories in this section. Immersion and coming up with surprising new ideas was evidenced mainly through field notes and one rich audio instance. For example, on 3rd July 2015 students’ engagement was shown to be maintained through banter “Students were engaged in story construction most of the time but also used the story in their banter in between turns” and that this sometimes led to surprising ideas “Stop man, retardedness is an illness” the student responds to a student who called him a retard but then used the

word in the game associated with the person who said it. Facilitating immersion for the rest of the group was only evidenced through one rich instance making this category the least evidenced through game play analysis. In the last pilot on July 7th 2015 one student did this by introducing a word which appeared in the previous session which everyone found funny, when he said “Trapping”.

From the English secondary 2 wheels, all of the students thought they were getting engaged in C2Learn and taking risks quite a lot. Three students identified themselves as taking risks a lot even though there was no evidence of this in the rich audio instances. One of these students was the most vocal, but the others were two of the least vocal. Again, this could suggest that the risk taking was occurring through suggestions to others rather than being outspoken.

From the Austrian data, most students seemed to be very immersed in C2Learn activities. The Headteacher commented: “They engaged very heavily in it. They produced this text, they typed it in, they had discussions about it. They were very much part of the whole process and very involved.” He also mentioned that students seemed to enjoy the activities which did not require using the tablets (especially because of the technical difficulties): “Everything that didn’t have anything to do with the tablets, with technology, they were very excited about and worked well”. This was confirmed by one student who said that she enjoyed the discussions a lot but wasn’t a big fan of using the tablets because they weren’t working properly a lot of times. Having said this, the students also seemed to have a hard time leaving their comfort zone, for example in the dance workshop. The Headteacher commented, that perhaps because of peer pressure and fear: “Most of them didn’t leave their comfort zone and didn’t want to leave it.” Regarding sustained immersion, the students themselves said that being part of a group made it easier to concentrate and focus. However, both the teachers and the researchers reported different findings saying that: “They distracted each other.”

However, through immersion, Austrian students managed to come up with surprising ideas in the gameplay. They used various cards as symbols to give them more meaning, for example: “We had Conchita Wurst and we decided not to use her as a person but as a symbol for being different.” Another example was the idea of having a tree being the narrator of the story instead of telling it from a human’s perspective.

Overall in the three sites, there was a small amount of data which suggested the students were engaged in the game, with this mainly being maintained through conflict in English secondary 2, and evidenced in Austria to varying degrees dependent on the participant source. There was also evidence across both countries of students generating surprising ideas. There was some evidence of risk-taking in English secondary 2 wheel data, but students shown as not keen to leave their comfort zone in the Austrian data.

4.1.5 INTERVENTION AND REFRAMING

(Specific changes in thinking patterns, and in particular reasoning processes. Changes in expression, primarily in linguistic terms, but also encompassing other modes as well.)

In English secondary 1, a small amount of evidence suggested students were sometimes reframing the story. The evidence was mainly taken from the rich film instances and was one of the most evidenced of the WHC categories through rich instances. One of the students in the first pilot was reframing the perspective of the story in surprising ways. Green demonstrated interesting ideas about where the feeling of guilt would come from if a woman was raped, he said: “She felt guilty because she had an unlawful child”, then he said that the rapist would return to look after the baby: “It was a miracle the man who impregnated her returned to look after her” and finally he gave power to the innocent baby to eliminate everyone “The baby came and blew them all up”. The teacher thought that the unusual reframing occurred because of the use of the card the student had: “Some students were given a lovers card and they were suggesting that perhaps the rapist and the victim ended up becoming lovers and partners”.

In English secondary 2, there was a very small amount of evidence across three out of the five categories in this section. Evidence was taken from a field note which stated that “Players reframed words to fit in with their own direction of the story and added their own words in unusual ways too”. This was also evidenced in the rich audio instances with one particular student who dominated the ideas. Some of the evidence showed the student making new connections this way, for example Ali said: “I ran into my friend John who had a reflection reflecting off his bald head I needed a shroud to protect my eyes” Here, the student reframed the accumulation of his own ideas to generate a more creative entry.

The English secondary 2 wheel data showed mixed ideas about how much students thought they were thinking in a new way. One student thought he was thinking in a new way a lot. Again this was one of the students with the least amount of input evidenced in the rich audio instances, but who also recorded himself on the wheel as exploring new ideas and making a positive difference a lot. This could suggest that this student sees a connection with these two categories. The students who rated themselves as thinking in a new way a bit, rated themselves as either a lot or quite a lot in all of the other categories suggesting that they did not believe they were thinking in a new way even though they thought they were participating quite a lot.

In the Austrian secondary data, intervention and reframing was evidenced through the SDs. For example, instead of focusing on hope and survival the students decided to write a story about destruction, the end of the world and a tragic future, if we, as human beings, continue to be inactive. The beginning of their story was: ‘Plants and animals are suffering because roads are being built.’ The students mentioned one turning point in the story and stated that its ending was the most important aspect in their opinion. One participant wanted the ‘whole universe to decay’ whilst the other group members thought this idea was ‘too dramatic’ and suggested that only the tree (being the narrator of their story) and the environment around it were being destroyed by humans saying that: ‘the earth dying doesn’t mean that everything else is dying as well’. Even though they were negotiating conflict through discussion and eventually decided to settle on a less intense ending, they

still came up with the collaborative thought ‘destruction due to progress’. They all agreed on that moment being the most crucial and interesting part of the story and were very reflective about their personal opinions.

Overall in the three sites, there was a small amount of gaming data and the SDs to suggest students were using intervention and reframing in the gaming experience, and were aware of how it functioned. The main evidence showed that students were intervening and reframing in order to develop a new perspective on the challenge or within their developing story, and that when they did this they created surprising ideas, that were sometimes ethically driven.

4.1.6 4Ps

(Evidence of high participation [engagement and involvement], high pluralities [taking on many roles, personae, perspectives], high playfulness [operating in an as if and playful manner] and high possibilities [generating many ideas through what if and as if thinking].)

In both English secondary 1 and English secondary 2, most of the examples identified in the rich instances demonstrated high participation or high possibilities which demonstrated some involvement and engagement in gameplay and that students were thinking about some possibilities through the cards. Pluralities was evidenced only in English secondary 1 where one student who was thinking about the dilemmas of both the rapist and the victim in one instance “It was a miracle the man who impregnated her returned to look after her”. Playfulness was evidenced only in English secondary 2, in a small amount in the rich audio instances. For one student, it mainly came from the use of the words provided for the story, for example: Ali says uses the word ‘Trapping’ to express his feelings about the school “Sometimes I feel like trapping off from this school”.

In English secondary 1, five of the students marked high or very high participation on the axes. In English secondary 2, all of the students rated the sessions with high participation and possibilities overall. The student who was whispering throughout the sessions rated the possibilities of the games off the scale in the positive section, suggesting that although he was not evidenced taking part vocally, he enjoyed the sessions a lot.

In the Austrian secondary data, group dynamics could be seen in all of the gameplay activities. This led to different degrees of participation with some students being leaders and setting the tone and other students being more reserved and participating less (see ***Being in control***). One rich instance that occurred during the Gameplay and has been mentioned before (see ***Attending to ethics and the impact of ideas***) is a good example for evidence of high participation, high pluralities and high possibilities:

Annette: A lot of animals fled frantically from the approaching civilization. Andrew: Oh no!
Annette: I don't want the 'painter'. (Note: card) *Francine: They didn't find food anymore.*
Andrew: We have good cards except for the humans.
Francine: I don't know. There might be a way to incorporate the humans.
Annette: We could say that they are coming by or something like that. *Andrew: National player.*
Francine: We are supposed to

tell different stories. On the one hand, what happens with nature, with vegetation and with flora and fauna, on the other hand it's about the imbalance between... Andrew: Maybe we should write that politics and humans become more radical, exclude everyone and the artists want to do something against it. Francine: Because he is active. He is an activist...which is why they show that in their paintings and paint it.

This instance is high on participation because every group member took part in the dialogue. The students took on different perspectives, saying that they want to describe what happens with nature as well as with society. They also thought about different ways of using the stimulus and discussed different possibilities for continuing the story.

Overall therefore across the three sites there was evidence of high participation and possibilities, with less consistent evidence of pluralities and playfulness in the English data. In Austria there was more consistent evidence of pluralities, but again less playfulness which could be put down to the serious nature of the topics under debate in all three sites.

4.1.7 UNDERTAKING A JOURNEY OF BECOMING

(Over time, noticeable changes in participants' dispositions and/or personalities. This may involve smaller incremental changes.)

In English secondary 1, the two groups were different in each session so no journey of becoming occurred.

In English secondary 2, evidence in the field notes shows that there may be small changes within the most dominant student. Ali tended to take control of the story construction but at the end he started to include others more and let them have control: ““This student also started to include others more by asking them to contribute individually, thus letting go of the control of the direction of the game”. However this is minute evidence of a fledgling journey of becoming.

In the Austrian secondary the main change evidence was that some students showed higher participation at the end of the project. Similarly to the English secondary data, while there were leaders in every group a few of the pupils managed to speak out more often and be more active in the course of the project. The teacher noted that: “Some pupils, especially those that were quiet at the beginning (of the project) and are more quiet in general were less afraid. They managed to find their niches and got more involved. You could see some development.”

However overall this evidence is on a very low level, as the project were not long enough to anticipate journeys of becoming.

4.1.8 GENERATING QUIET REVOLUTIONS

(Over time more noticeable changes in the creative community stemming from creative ideas generated; might comprise smaller incremental changes.)

No evidence of quiet revolutions was recorded in any of the three sites. However, this was to be expected given that quiet revolutions are anticipated to take place over extended periods of activity, which was not the nature of these pilots.

4.1.9 PEDAGOGIC STRATEGIES

(Evidence teachers proactively valuing learners' ideas and actions; enabling learners to take the initiative; ensuring sufficient space and time for ideas and actions to emerge getting alongside the learner and learning as fellow collaborator.)

There was no evidence regarding pedagogy in English secondary 2. Although, in English secondary 1, there was one comment from the teacher which showed how he was allowing the students space to try things out for themselves when he said: "and I kind of let them run with it a bit because I wanted to see how they got on". He also thought that the session led to other areas of the curriculum through the discussion that occurred: "we were able to apply it to some perspectives in victimology". When asked how he would use the game in the future he replied that he would be "Getting the students to work in 2s or 3s to a different stage of the game where the whole group is contributing to the story, that would make it competitive but they would be collaborating in small groups".

In the Austrian secondary analysis, since the activities were implemented without teacher intervention there was no focus on pedagogic strategies. However, the head teacher talked about his experiences using technological tools like tablets in class and how he is trying to incorporate them in a sensible way (see 3. What role is played by C²Learn technological tools and corresponding pedagogical interventions, focusing in particular on students' experience?).

Question 1 summary for main categories

Therefore, overall across the three sites, the evidence showed that the European 15 to 19 year old students were thinking about the ethical impact of their new ideas, and were exploring and actioning ideas. There was some evidence of them engaging in dialogue in England and more evidence of this in Austria. There was a small amount of data across the three secondary of the students being in control in different ways, and of being engaged in action in the games in order to generate surprising ideas. There was also a little evidence of risk-taking in the English data. There was a small amount of data from all three sites to suggest students were using intervention and reframing in the gaming experience, and were aware of how it functioned. Overall across the 5 co-creativity categories, it is therefore possible to say that the secondary students evidenced some co-creativity when they were engaging with C2Learn tools and environments. Out of the 4Ps, participation and possibilities were the most evidenced across the three sites; there was some evidence of pluralities in Austria and little evidence of playfulness in any of the sites perhaps due to the serious nature of the topics under debate in all three sites. Perhaps to be anticipated, there was little evidence of journeys of becoming or quiet revolutions because of the curtailed length of the pilots.

2. How does manifesting of co-creativity (WHC and CER) in C²Learn change over time?

Assessment of students' *lived-experience* in terms of co-creativity along the WHC dimension.

In English secondary 1, the same children did not play over time, but in English secondary 2, there was some repetitive play. However unfortunately this was not consistent enough to show change over time.

In Austria, all of the above-mentioned instances occurred in the course of the project. Changes over time could be seen but mainly when it came to particular students being less afraid to voice their opinion at the end of the week (see *Undertaking a journey of becoming* above). However, regarding the other WHC dimensions there did not seem to be detectable changes. Looking at the video footage from the gameplay, the students were less concentrated and focused on the last day of the C2Learn week but still tried to incorporate the different elements and cards in a meaningful way. In Austria, statistical comparison of the PRE and POST data (additional to that designed in the main assessment methodology) was undertaken and this may give further insight into possible changes.

3. What role is played by C²Learn technological tools and corresponding pedagogical interventions, focusing in particular on students' experience?

No evidence was recorded in the three sites. However in the Austrian secondary site, the Headteacher offered some generic insight. He pointed out that employing tablets or notebooks as teaching tools comes with a lot of challenges and needs good preparation, saying that he prefers to use them as a gimmick rather than on a day to day basis. Technological difficulties can often lead to the students being less concentrated and focused which is why the head teacher recommended using tablets with smaller groups, and that he felt tablets are more appealing to his younger students. Some of the students also expressed frustration because the tablets did not working properly during the project: 'I am not a big fan of tablets. But I think if you prepare games like that, they should work.' (Francine)

4. Development and refinement of C²Learn's Assessment Methodology tools with particular focus on:

[a] Tailoring of categories to C²Learn's game(s)/gaming environment.

None recorded in English secondary 1 or 2. The Austrian team fed back that they would recommend exploring the categories with the existing data further to be able to provide a clearer definition of them (both conceptual and operational).

[b] Developing the Socratic Method type interview protocol in relation to C²Learn's game(s)/gaming environment.

None recorded in English secondary 1 or 2. The Austrian team fed back that the Socratic Dialogue proved to be an interesting tool for collecting data. However, I think it could be a good idea to develop a protocol which focuses more on the WHC categories to make the analysis easier.

[c] Specifying the Computational Creativity metrics to be used.

None recorded in the three sites.

[d] Refining the rest of the evaluation tools in relation to C²Learn's game(s)/gaming environment.

In English secondary 1 and 2, the words A lot, Quite a lot and A bit need to be moved in order for it to be clearer for the students to understand that section needs to be ticked. The English team fed back that it may need a clearer explanation of the connections of the categories on the wheels to how they relate to participation and possibility thinking.

The Austrian team fed back that grid and axes values were added to the 2Ps Axes to make it easier for students to mark their position in the chart.

They also adapted the Creativity Wheels by using a five-level Likert scale instead of a three-level one to give the students more options to express their opinion. They also aim to use statistical analysis to show how these changes affected the data. However it should be noted that the English team who designed the wheels still emphasise that they are a dialogic tool for tracking lived experience rather than a quantitative, statistically analysable tool.

5. SOCRATIC DIALOGUE REVIEW BASED ON THE PILOT FINDINGS

This section consists of a review of the Socratic Dialogue (SD) tool, based on findings from all phases of C²Learn piloting (M21, M30 and M36 Pilot Cycles). Although SDs were first introduced as evaluative tools, it became clear early on that their utility extends further. Premised on this, what follows is an exposition - through examples from the C²Learn pilots⁴ - of SD's utility on 3 interrelated levels:

- As a **reflective tool**, enhancing C²Experiences and promoting a deeper understanding of them by the participants.
- As a **co-creativity fostering tool**, enriching C²Learn's toolkit.
- As an **evaluative tool** facilitating the evaluator's work and providing additional insights.

To facilitate the exposition, it is better to start with a brief description of the example C²Experiences used. All of them involve the creation of stories on the part of the students using, primarily, different versions of the C²Learn game: *4Scribes*. Below we indicate the basic premises the students were given to develop their stories⁵:

Exp1: *After a plane-crash 12 people are in the water. There is a life-boat but it has room for only 11 people. What do you do?* [Greece]

Exp2: *You're a Greek farmer living at the time of the Ottoman Empire. You feel wronged because the tax collector took more wheat from you than your allocated due. You decide to voice your complaint to the Pasha, who accepts to give you audience.* [Greece]

Exp3: *You and your team are lost in some mountain. What do you do?* [Greece]

Exp4: *A girl wakes up in the hospital after trying to commit suicide.* [Austria]

Exp5: *Ecology themed. Modern society and the environment's destruction.* [Austria]

Exp6: *The animals of a circus company are being treated cruelly. Unfortunately your parents work for that circus. If the circus closes down your parents will lose their job.* [UK]

5.1 REFLECTIVE TOOL

Due to the nature of SDs, i.e. dialogue prompted by questioning, there were many cases of constructive reflection by the students in all of the C²Experiences. It is very interesting to note how SDs allow for very different lines of enquiry, and correspondingly gives ample opportunity to the students to explore and analyse their experiences in many different ways.

⁴ The examples are referenced from: Stenning, K., Schmoelz, A., Alexopoulos, K., Aichhorn, A., Stouraitis, E., Wren, H., Scaltsas, T, Karen, K., "Creativity through Socratic Dialogue?", *Digital Culture and Education*, 2016 (Under Review)

⁵ The country the C²Experience took place is given in brackets.

Within the context of **Exp1**, the students were able after some discussion to grasp and use the notion of a *reframing* – one of the main dimensions of C²Learn creativity. Students were able to identify events within their own story that functioned as *reframings*, and connect these events with particular actions/decisions by players. The use by one of the students of a card to bring in God, who introduced a new rule, as well as the use of another card by another player to sink the boat, were recognised (amongst others) as strong cases of *reframing*. It is important here to note that associating *reframings* with card-use provided the students with a deeper understanding of the game and its rules. During the whole play-session the students adopted a light-hearted humorous attitude towards their problem, and it was during the SD that they became more aware of this attitude, when juxtaposed to the seriousness (life or death situation) of the story's premise. This led to attempts at analysing their own behaviour.

Exp2 and **3** offered similar findings. The students were able to identify key *reframing* points in both stories. What's more in **Exp2** students were able to reflect on the trajectory of their story, the importance of a historical setting as premise, and their difficulty in creating a story that stayed within the given historical setting. In **Exp3** the students reflected on the use of random cards and the difficulty this presented in creating a coherent story.

In **Exp4** the discussion took the form of a debate. After identifying 2 crucial *reframings* - one involving the visit by a celebrity, the other involving the girl exiting the hospital after a week – the students proceeded to debate as to which was the most important one. As part of this process the students came to express the basic qualities of each *reframing*, with the first being characterised by the notion of “fun” and the second by “recovery”. This essentially opened a deeper layer of analysis to the notion of a *reframing*. The students became proficient enough with the notion to be able to discern particular qualities of differentiation between them. In the end “recovery” won the day. It is also important to note that the students were able, through the discussion, to detect patterns in their decisions, stemming from their own personal experiences and how these related to those of the characters in the story

In **Exp5** the collaborative identification of the ending's theme - an expression of the idea: “destruction due to progress” – as the crucial *reframing*, led to more discussion on the relationship between modern society and nature, as well as consumerism, conformism, not-taking-responsibility and technology abuse. It was the SD prompted discussion that allowed the students to elaborate end explore subjects related, yet not touched upon in the original story.

In **Exp6** the first SD session on the deeper theme of the story created. Although initially identified by one student as “more about death”, this conclusion was later challenged by another player, who had used a card to “bring everyone back to life”. During a second SD session the questioning focused more on the use of the cards. This allowed students to go into much depth on the best card-strategy (e.g. one player suggested that using characters in the beginning and objects at the end was optimal), particular incidents and interconnections between card uses (e.g. how one player's decision to have a character fly to instigate a *reframing*, allowed another player to use the “fallen” card on that character),

as well as general observations on the game (e.g. the pros and cons of being the player ending the game).

To sum up the above, the students' reflections - prompted by different lines of questioning within the context of SDs - centred primarily on the following:

- The notion and examples of *reframing*.
- The nature, point and rules of the game, as well as questions on play-strategies.
- The meaning and structure of the stories created.
- Issues related to and branching out of the themes of the stories.
- The players own behaviour, choices/reactions during gameplay.

5.2 CO-CREATIVITY FOSTERING TOOL

Some aspects of co-creativity fostering are already evident in the use of SDs as a reflective tool. Firstly by facilitating the understanding and further use of the notion of *reframing*. Conscious employment of this notion in analysis is a first step towards its employment within the creative process. This is connected to a deeper understanding of the rules and/or conditions which structure the frame (in this case: C²Learn games) within which the creative process takes place. (See e.g. **Exp1, 3, 4** and **6** for strong examples of both these aspects.)

Another level of co-creativity fostering consists in training their "eye for connections". In most cases, as we saw above, the children were able upon reflection to discover deeper interconnections between their actions/decisions (e.g. **Exp6**), but also between the themes of the story and related subjects and issues (e.g. **Exp5**). Equally interestingly the students even used the SD in order to completely reframe the whole story (e.g. in **Exp6** a player used God and the Devil, during the SD process, to save the circus animals) thus actually extending the creative process.

Lastly through the use of SDs the students were able to i) negotiate conflict and collaborate (e.g. **Exp4, 5** and **6**) and ii) access the underlying emotional connections and patterns that shaped or framed the creative process (e.g. **Exp1** and **4**); examples of the dialogic and emotive dimensions central to C²Learn's conception of co-creativity.

5.3 EVALUATIVE TOOL

Through questioning and discussion between the researchers and students, but also between the students themselves, the researchers were able to i) gain access to hidden or implicit aspects of the students' cognitive processes, as well as ii) clarify and enhance their understanding of the students' decisions/choices.

Reviewing the SD sessions allowed the researchers to form a much more cohesive and holistic understanding of the players' actions and their interconnections. An indicative example is the player who sank the life-boat in **Exp1**. This particular player was relatively

'quiet' during play, yet through questioning the player was able to open and explain this particular decision. The result was the recognition - by the researchers and the rest of the students - of this particular action as a seminal point of *reframing* within the story. Similarly in **Exp2, 3** and **6** the researchers gained a much deeper understanding of the players actions, and in Exp6 in particular the SD revealed the very different interpretations the players had given the story (i.e. "death" or "life" interpretations). Interestingly, in **Exp3** the students themselves used the SD process to self-evaluate their performance in using the cards.

Within the context of **Exp4** the SD process was instrumental in uncovering an ethical dimension in the definitions of the 2 crucial *reframings*, as well as in the subsequent choice of one of them. This ethical dimension is an integral part of C²Learn's definition of co-creativity, and may have gone unnoticed without SD questioning. The same can be said of the emotive dimension revealed there, which also served as further clarification for the students' preference of the "recovery" *reframing* (e.g. some of the students recanted personal stories of family members who had gone through similar experiences). Similar points can be made for the use of SD in **Exp1**, and **5**.

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