

‘Collaborating2Create’: A conceptual tool to develop learners’ capacity for collaborative creativity through Virtual Internships in schools

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Abstract

Background:

Many employers are clear about the skills future workers need: technical and practical skills, alongside transferable skills including an ability to effectively solve problems and to work creatively within a team. School-based ‘Virtual Internships’ offer potential to respond to these calls, enabling learners to engage in pedagogically-aligned challenges grounded in authentic workplace practices. Limited research has, however, investigated how schools may facilitate authentic workplace experiences virtually – through online interaction as well as role-play of workplace practices: to enable young people to develop important competencies around creative groupwork through curricular activities.

Aim:

In this paper we outline the development of ‘Collaborating2Create’ (C2C): a conceptual tool devised through the ‘Virtual Internships Project’ to support the teaching of group creativity, in a way that meaningfully links education to the world of work.

Method:

We offer a critical literature review followed by extracts from qualitative discourse analysis of classroom data, selected to evidence the value and practice of C2C in genuine classroom interaction. Extracts are presented with integrated analytic commentary, followed by a summary, to make salient features of dialogic interaction that promote C2C. Extracts from a teacher post-programme interview and student focus group, around the deductive theme of C2C, are incorporated to evidence how the programme was developed iteratively based on learning from trials.

Findings & Implications:

This paper argues that C2C conceptualised as a ‘complex competency’ within a broader Virtual Internship programme offers a conceptual tool that can be embedded and have value beyond the current project. Further, many charities and businesses are keen to establish links with education but their capacity to engage learners in schools is limited. It is argued that C2C could act as an effective ‘bridging concept’ between education and the world of work.

Keywords

Creativity; Collaboration; Dialogue; Enterprise; Education

1. Introduction

By the time somebody aged 11 today is 21, it is conservatively estimated around 400 million people globally will have lost their jobs due to technological advances (Manyika, et al., 2017). However, the same advances in technology will also provide new employment possibilities, new categories of jobs being created and the redefinition of many existing roles (World Economic Forum, 2018). New approaches to education are needed if young people are to take advantage of such opportunities. It is important to note that these figures relate to

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the outlook before COVID-19. The complex competencies of enterprise and innovation are likely to be even more in demand in the post-pandemic world, as people grapple with new situations and forms of interaction (World Economic Forum, 2020).

This paper is motivated by increasing attention to one complex competency: working creatively in a team. It considers the value of linking education to real-world contexts to promote 'group' or 'collaborative' creativity, where group creativity is oriented to authentic workplace challenges. In so doing, it responds to recent calls for schools to better develop learners' capacity to be creative (Richardson & Mishra, 2018).

Drawing on empirical examples, the paper presents a conceptual tool to support teachers in facilitating group creativity in the context of secondary (high) school provision. Specifically, the paper reports on the conceptual development of 'Collaborating2Create', or C2C. C2C is a tool for supporting teaching and learning in a way that embeds a focus on creativity as a collaborative engagement by linking authentically to the world of work.

1.1 Background to the 'Virtual Internships Project' (VIP)

At present, school curricula often struggle to authentically engage young people with the world of work (Alfeld, et al., 2013). Such links are often restricted to active contacts with key staff or parents, and difficult to maintain beyond the focal event or intervention (Davies, et al., 2013). Even before COVID-19, researchers and practitioners were beginning to acknowledge the idea that taking students 'out' of school *virtually* may offer strong benefits for the development of complex competencies (for instance the work of Shaffer and colleagues, predominantly with Higher Education students). Such education enables links to real-world work contexts, so learners experience the potential of enterprise and innovation for themselves and build relationships that motivate and inspire them. Clearly in the wake of physical restrictions for educational and workplace practice brought about by the global pandemic, facilitating virtual experiences, communication and engagement has timely and ongoing potential.

There is considerable history to the idea of Virtual Internships, as mentioned above particularly through the work of David Williamson Shaffer and colleagues. Whilst certainly influenced by this body of work, the Virtual Internship work presented here differs in significant ways:

- students and teachers access VIP materials online and use digital tools as appropriate, but project work and communication can be offline, by co-present group members and facilitated by the teacher. 'Virtual' is thus interpreted as role-playing workplace practices, simulating practices in the sense of an 'epistemic frame' (Shaffer, 2004, 2006, 2007), and taking on the 'mantle of the expert' (Fields & Enyedy, 2013; Heathcote & Herbert, 1985), in responding to authentic workplace challenges;
- the involved industry partners who funded the project represent global organisations who are named and familiar to students (British Telecom and Huawei), not fictitious companies;
- co-present teachers are subject experts, and broker Virtual Internship experiences for their students. Facilitation of content is largely in the hands of the curricular teacher;
- students and groups are encouraged to continue work on their Virtual Internships outside timetabled slots;
- partnership with industry colleagues has informed the development of resources throughout the programme (including video induction and challenge setting; structuring authentic evaluation criteria; and worksheets to support various processes and organisation). However, during the present version of the programme such experts are not 'on hand' as groups engage with their challenges. Students are therefore encouraged to use their initiative, group members and teacher as resources in overcoming challenges.

Having outlined the project rationale and context, and before reviewing pertinent literature, it is important to state the research question guiding this paper:

How can a conceptual tool be developed and used to support teachers and learners in

a) promoting collaborative creativity

*b) and authentically linking education to the world of work;
and what would such a tool look like?*

2. Creativity and collaboration in the classroom

In this Section an overview of the creativity in education literature is offered, particularly considering how collaborative creativity is framed. This is followed by exploration of how such framings are built upon or reinforced by links between education and enterprise, identifying the significant role C2C could play when embedded through a Virtual Internships programme.

2.1 Reviewing key arguments from existing literature

Various systematic, scoping and bibliometric reviews exist of the creativity in education literature, as researchers have sought to organise key arguments, positions and definitions that span multiple subject domains and research disciplines (e.g. Banaji, et al., 2010; Hernández-Torrano & Ibrayeva, 2020; Plucker, et al., 2004). Despite being an area of academic research since at least the mid-20th Century (Runco & Albert, 2010), there remains no widely-held definition of creativity or what it means to be creative, and there is substantial variety in views of how a capacity for creativity can be taught in schools. There is however strong evidence for the value of constructing a 'safe' (Davies, et al., 2013) and dialogic space (Chappell, et al., 2019; Ludvigsen, Ness & Timmis, 2019), that maintains balance between structure and freedom, in enhancing students' creativity (Brem, et al., 2016). Aligned with this dialogic view, recent research has prioritised the collaborative nature of creativity (e.g. Moiranoa, Sáncheza & Štěpánek, 2020; Pifarre, 2019; Sawyer, 2011), as in Littleton and Mercer's (2013) 'intermental creativity zone', compared to earlier views of the 'lone genius'.

Sawyer in his 2007 book for instance states:

We're drawn to the image of the lone genius whose mystical moment of insight changes the world. But the lone genius is a myth; instead it's group genius that generates breakthrough innovation. When we collaborate, creativity unfolds across people; the sparks fly faster, and the whole is greater than the sum of its parts. (p. 7)

This focus on collaborative creativity emphasises that the group process can be far richer than the total of what each individual can do on their own: thus, there is considered to be something enhancing about the nature of group interaction that facilitates this creativity. But this is not seen to apply to all groups and all group interactions – so what is it that promotes this added creative value, and can it be taught?

There is abundant research and literature proposing that creativity can and should be taught. Much research advocating for teaching creativity however runs counter to the restricted and prescribed nature of the curriculum and assessment regime most schools and teachers are monitored against (e.g. Edwards & Blake, 2007; Henriksen & Mishra, 2015). As Banaji, et al. (2010) highlight:

at the level of policy, creativity is being constructed in quite contradictory ways: it is supposedly overwhelmingly important, but also marginal to the mainstream curriculum in terms of time and resources. (p. 23)

Some research appears to maintain a distinction between 'creative' and 'non-creative disciplines' (Gustina & Sweet, 2014), suggesting there is either a different need for or form of creativity between such positions, or that creativity is more or less relevant or natural

depending on which discipline is invoked. This raises questions as to the potential transferability of creativity as a process, if it is so domain specific. This position was however countered almost a decade earlier in an editorial by Faulkner and colleagues (2006):

We deliberately wanted to move away from the commonly held assumption that creative and cultural education is the preserve of the arts rather than the concern of the curriculum as a whole. (p. 193)

This is precisely the view taken in developing Collaborating2Create within VIP: as a conceptual tool to support education design, and to set explicit 'dialogic intentions' (Warwick, et al., 2020) that teachers can monitor and students can understand. But research is also clear that creativity is not just valuable for its own sake, but for supporting students' transition from education to enterprise – in fact it is argued to be one of the 'complex competencies' required, but said to be often missing, as students enter the workforce (e.g. Gube & Lajoie, 2020), as Section 2.2 explores.

2.2 Developing learners' capacity for collective creativity by linking education and enterprise

Research is clear that some skills required of employees (including creativity and creative collaboration) are not being developed through 'traditional' schooling (Gube & Lajoie, 2020). This is arguably a strong rationale for Shaffer and colleagues' instantiation of Virtual Internships, in forming customised design-based modules around fictitious companies, to induct future engineers into the 'epistemic frame' (Shaffer, 2004, 2006, 2007) of engineering. Aligned to this, one argument around teaching for creativity emphasises the value of involving outside organisations, and taking students 'out' of school, in building creative learning environments (Davies, et al., 2013). In their systematic review, Davies, et al. (2013) identified the value of partnering with non-school bodies, but with the added warning that often, 'the lessons from such "critical events" do not readily become incorporated into everyday practice once the special project has finished.' (p. 84). Thus research and interventions need to capitalise on valuable relationships with external organisations, where the positive impacts of such engagements are reinforced outside and beyond the intervention or event. Within VIP, it is contended that this 'taking out' of school could be facilitated virtually – online or through simulation and role-play – such as through video resources from industry colleagues representing authentic workplace practices and challenges, and in structuring classroom-located but workplace-informed activities. Utilising schools' existing digital platforms, such mechanisms could also support a longer trajectory of education-enterprise engagement. In the post-COVID world, such virtually-resourced activities are likely to be more necessary, prevalent and indeed relevant.

2.3 Taking the literature forward: the need for a conceptual tool to support collaborative creativity

As demonstrated in the above review, creativity in education is not a new area of research. It remains however a field where central concepts are considered vitally important whilst being simultaneously hard to define, teach, measure or 'prove'. There is growing evidence that emphasising and encouraging collaboration and dialogue in addition to creativity can be effective – as a combined intention and effect on processes, interactions and products. There is also evidence particularly from the HE sector, that a Virtual Internship model can support students' meaningful engagement with workplace practices, and contextualised development of such competencies required by the world of work. On this foundation, this paper builds on extant literature in responding to several of the issues presented. Specifically it makes the case for C2C:

- by evidencing the value of taking students 'out' of school virtually – through Virtual Internships;
- through genuine partnership with industry colleagues in crafting, voicing and resourcing these experiences;

- in building students' capacity for collaborative creativity, making it an explicit and resourced dialogic intention, through developing students' awareness of and attention to 'Collaborating2Create'.

3. 'Collaborating2Create' (C2C)

This Section offers a rationale for C2C and outlines what it involves, to illustrate how it can be implemented and observed in practice.

3.1 C2C as a specific conceptual tool to support education design

As identified in Section 2, calls are rife in policy, politics and media, that creativity is a complex competency which will be crucial for current and future generations' lives. Despite the challenge of pinning it down, creativity indicates something that is desired: in education, in the world of work, and in social interaction in general. As Gube and Lajoie (2020) articulate:

In order to give university graduates the skills and attitudes they will need to be productive members of our rapidly changing society, higher education must approach teaching and learning with a sharper focus on flexible, adaptive skills and attitudes that support creativity and innovation, rather than imparting a body of inert knowledge. (p. 1)

This is a commendable statement, but what about supporting students before they do (or do not) consider Higher Education, or start to make (and rule out) career choices? As previously cited, research is clear that creativity is rarely an individual activity (e.g. Sawyer, 2007). Hence, supporting effective group working practices is core to successful, creative problem solving. Equally groupwork is only successful if group members genuinely talk and listen to each other, being open to alternative views and to checking their own and others' understanding. In terms of schooling, this requires the building of a classroom culture where such practice is encouraged.

Regarding characteristics of classroom talk that can support collaborative creativity, these include (drawing on Barnes, 2008; Littleton & Mercer, 2013; Mercer, et al., 2004; Mercer & Littleton, 2007; Mortimer & Scott, 2003; Wegerif, 2005), but are certainly not limited to:

- Teachers leaving longer pauses to encourage pupil input and reinforce that pupil input is valued, as well as showing that the process of inquiry is as important as the product or answer;
- Students asking questions – of themselves, of peers, of teachers, of the domain, of experts;
- Varying the types of questions posed by teachers and students: asking questions to which answers are not known; asking open questions that may require all to do some research, and may generate multiple plausible responses – allowing students and groups control over which direction to take a challenge;
- Multiple perspectives, potentially disagreements, being voiced – and attention to how these are negotiated.

Aligning the pedagogy with the world of work, VIP's industry partners noted that employers often give interviewees team exercises, asking them to solve problems on the fly. VIP partners also confirmed that interview candidates are often asked questions such as 'can you tell me about where you have worked in a team, solved a problem, overcome a challenge?'. Such comments highlight the need to pay explicit and dialogic attention to collaborative creativity within education, whereby discussions with industry colleagues directly fed into the developing conceptualisation of Collaborating2Create. Building on Gube and Lajoie's conjecture above, supporting these experiences and reinforcing such skills in school, through a pedagogy directly designed to develop these skills, could substantially enhance students' preparation for the world of work.

To reiterate, the aim of this paper is not to ‘test’ or ‘measure’ creativity, but to offer a research-informed conceptual tool for teachers toward a pedagogy that seeks to promote a collaborative, creative classroom culture. Aspects of interaction and dialogue can however be identified, as outlined above and detailed in Section 4, as indicators in group talk that may facilitate creative exploration.

3.2 Collaborating2Create as a conceptual tool

Collaborating2Create (or C2C) as a response to the above needs, brings together the research, world of work and education aspects of VIP, as illustrated in Figure 1.

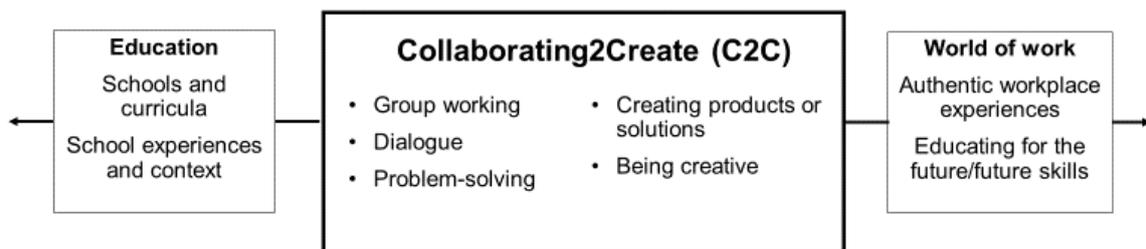


Figure 1: Collaborating2Create as a means of linking education and the world of work

The term ‘**Create**’ here refers both to the process of *creating* a product or solution, and also to *being creative*. The aim is not only that products are created, though this is one goal and often represents the assessed element of a project. A bigger goal of VIP is to support individuals and groups to be more creative: *to build their capacity for creativity*. The ‘**Collaborating**’ element involves the productive use of classroom talk, as students work together.

During VIP both the ‘Collaborating’ and ‘Create’ elements are developed together, as a composite conceptual tool to support educational design and practice. With this in mind, a focus on C2C was embedded throughout the VIP programme – refined across two iterations – and aligned to world of work needs, to support the development of students’ skills both in the moment and in preparation for real-world challenges beyond the project. This is critical – as highlighted in the literature review – so that a focus on collaborative creativity is embedded across, rather than siloes within, lessons or the curriculum overall. This in turn makes it more likely that such practices will outlast the catalysing intervention.

4. Inquiry Approach

Having stated the need for C2C, we now identify how the tool was developed to respond to the following question:

How can a conceptual tool be developed and used to support teachers and learners in

- a) promoting collaborative creativity*
 - b) and authentically linking education to the world of work;*
- and what would such a tool look like?*

In the previous Sections, theoretical debates were reviewed and key arguments for research and practice outlined: particularly the difficulty of defining and teaching collaborative creativity. The conceptual tool of Collaborating2Create presents a potential means of responding to this difficulty and gap. Section 5 offers empirical examples to illustrate meaningful links between education and the world of work, through interactions considered to exemplify C2C.

4.1 VIP's Design-Based Research framework

In this subsection details of the Design-Based Research (DBR) approach for VIP are shared to exemplify how C2C was both identified as a need, and developed collaboratively as a conceptual tool to support education design. This detail is offered here as the DBR approach was pivotal in framing the development of C2C.

The project overall, and approach in developing resources and working with teachers, is grounded in DBR (Bakker, 2019). DBR pays mutual attention to developing a workable design and to extending research and/or theory. It responds to demand for rigorous and systematic ways of developing practically-relevant educational materials, activities and environments, through iterative efforts to understand user needs, and evaluation of trials in practice.

The design-based element of the research was particularly important in grounding VIP in authentic practices of industry as well as schools' curricular requirements and practical constraints: in ensuring stakeholders had opportunities to influence the programme in meaningful ways that were implemented in design revisions. As a methodological framework, DBR operates a partnership model of research and development: where participating teachers are genuine teacher-researchers feeding into designs, trialling them in practice, and feeding back on successes and points for development. DBR is also therefore well placed, in its emphasis on partnership, to accommodate collaboration with industry partners. Through iterative development combined with research, DBR aims to understand not only what works, but also why and how it works. The empirical examples offered in Section 5 therefore were selected to illustrate the concept, rather than suggesting such interactions were observed across all VIP lessons or groups.

The process outlined in Figure 2 illustrates the iterative development of C2C as a conceptual tool, within development of the VIP programme overall.

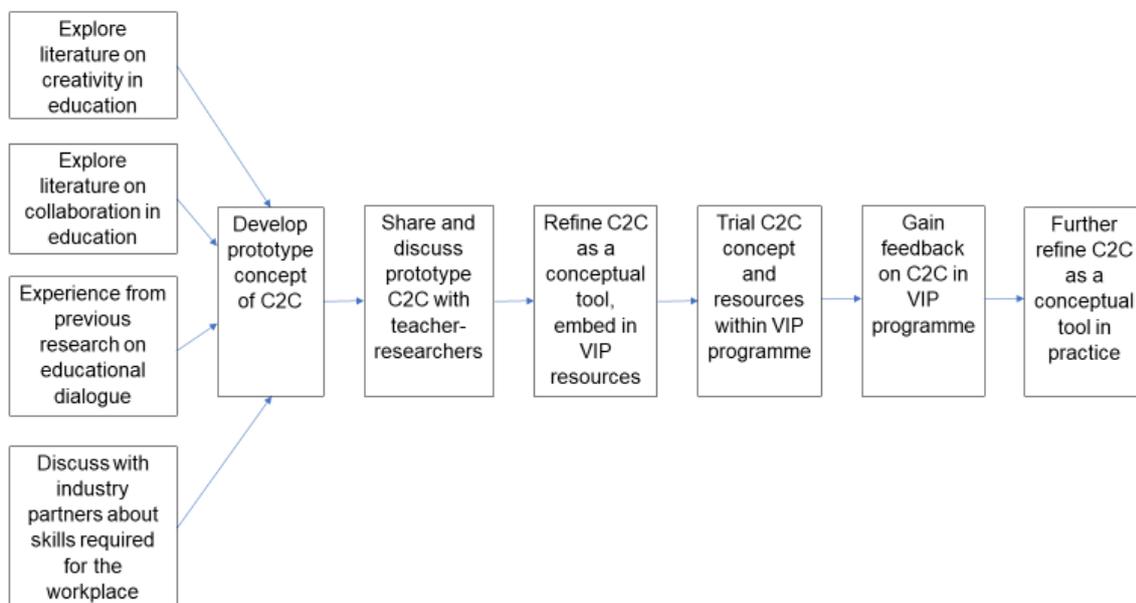


Figure 2: Process of developing C2C as a conceptual tool

4.2 Investigating Collaborating2Create as a research tool

The following Section presents extended extracts of lesson transcripts, selected on the basis of qualitative discourse analysis (drawing on Hennessy, et al., 2016; Mercer, 2004), to evidence how a focus on Collaborating2Create as a dialogic intention (Warwick, et al., 2020) can be developed as a skill and prove useful in responding to group-based challenges. These data examples address the stated research question by evidencing links made

spontaneously by students and the teacher between their tasks and workplace practices, maintenance of group ground rules for talk, and application of C2C. Data extracts from a post-programme teacher interview and student focus group were selected around the deductive theme of C2C (drawing on Braun & Clarke, 2006; 2020), to present reflections from teacher and student experience that informed the iterative development of C2C in the VIP programme.

On the basis of the elements of classroom dialogue identified previously, C2C can be explored through discourse analysis. Areas of dialogue considered to be productive for creativity can be outlined, and used to explore how often, when, by whom these occur and how they are taken up. On a broader level it can be used to address whether there is a sense of playful orientation to the problem – initiated and continued by the teacher and/or students – and whether ground rules for talk are negotiated, established, monitored, and upheld. Researchers can then analyse patterns of interaction, including:

- use of open questions (by the teacher, by some/all students);
- responses to open questions;
- number and type of alternative suggestions put forward – by the same/different people;
- extent to which alternative suggestions are explored;
- how disagreements are taken up and addressed;
- extent to which students explore the problem scenario, and/or seek to close down to a single solution;
- extent to which one/more students try to ‘lead’ the group.

In teaching for collaborative creativity, using C2C as a conceptual tool, a teacher might:

- ask open questions, with minimal use of questions to test students’ memory of rehearsed facts;
- ask open questions about the topic to which the teacher themselves does not know the answer – make it a collaborative initiative to learn about the issue, and to understand why the answer given might be appropriate. This could be particularly valuable if multiple answers are plausible, where students research, discuss and understand reasons for their answer. If all groups share their rationale, each group will learn something through their own research and by hearing that of other groups, and more importantly will understand why these interpretations are valid;
- encourage students to explore a range of possible ideas, answers and solutions to a task before closing down, and to query their own and others’ suggestions – this is not to criticise ideas but to *critique* them, to understand alternatives and choose the ‘best’ or most appropriate for current need;
- encourage students to voice disagreements, respectfully, so multiple voices are heard and different opinions can be discussed.

Transcribed and selected extracts include audible talk attributed to speakers, with notes added where talk refers to other objects. Approaches to consent, privacy and data storage were underpinned by the University of Cambridge’s ethical approval and safeguarding procedures, including BERA’s (2018) ethical guidelines for educational research.

Empirical examples that follow have been selected for illustration of contextualised enactment and potential, rather than to make statements about generalisable practices. This ‘cherry-picking’ could be criticised as a limitation of the approach and paper. However, it is put to readers that transparent reporting of conceptual development and iterative implementation offers value in lifting the lid on the complex interweavings involved in facilitating collaborative creativity, in emergent and authentic classroom interaction.

5. Empirical Examples

Consistent with the aims of the paper to exemplify C2C as a means to embed creativity in group work, and link education and enterprise in classroom interaction, two extended transcribed extracts of qualitative discourse analysis are presented below. These extracts were selected to evidence the value and practice of C2C as a conceptual tool and explicit dialogic intention, simultaneously linking classroom activities with workplace practices, in genuine classroom interaction. Extracts are presented with integrated analytic commentary, followed by a summary, to make salient features of dialogic interaction that promote C2C and support groups in working on their challenge. Reflections from a post-programme teacher interview and student focus group are then used to evidence how and why programme resources were developed, based on learning from Iteration 1.

5.1 Context

At this rural school, a Year 7 Design and Technology class (D&T, students aged 11-12 years) were using the VIP programme to address the global challenge of climate change or energy efficiency, and developing a local solution within their group. The school had a stated aim to improve students' use of dialogue, which the participating teacher was keen to encourage. In contrast, whilst being very willing to try the VIP programme (reporting a need to somehow approach things differently), the participating teacher was open about his general reluctance to use group work. Equally, whilst D&T can be considered an arena for creativity, it was acknowledged that students tended to be instructed in designing and producing the same objects, working to set intervals whereby the teacher offers instruction to all students. Thus students were relatively unaccustomed to working together and generating their own product designs in the way encouraged through VIP.

5.2 Example 1: From a 'leaf', to a 'tree', to an 'amazing great idea'

5.2.1 Participants

There were 14 students in the class. The focal group here were one boy and two girls (aged 11-12 years).

5.2.2 Teaching & Learning Focus

In the lesson in which the Extract below occurred, groups were designing a logo to represent their idea or product. The teacher had shown the whole class some internationally-recognisable, arguably 'successful', logos, and guided students to consider what words, images and colours would be appropriate to convey key elements of their idea.

The focal group were designing a charging unit that could charge six devices simultaneously, claiming also that devices would hold their charge for longer and that this charging unit would be more energy efficient than others currently available (note: the group were focusing on the design and idea of the product, not the technical capability to do this). As a group they discussed what they considered important in their design, that needed to be portrayed in the logo. The complexity of designing a simple but effective logo soon became clear, as revealed through the following extended Extract.

5.2.3 Example 1

All transcribed extracts use the following key:

T = teacher;

B1, B2, B3 = different male students;

G1, G2, G3 = different female students;

Analytic comments are given in square brackets and grey highlighted text

20.30–21.28

T	And now you've got to think about words or images that could be used as well, that would portray what you're trying to achieve with this idea. ((T leaves group))
B3	Image: a leaf. [B3: possible image 1 for logo]

	...
G2	A leaf? [G2: asking for more detail on possible image 1]
B3	A leaf, yeah, a leaf. Dunno. [B3: rationale for possible image 1 not yet developed]
G3	There could be like an apple and it could be like a (inaudible) to make sure that it's different. [G3: link to and differentiating from existing logos]
G2	Yeah, so it's not just like an Apple or something.
G3	Yeah because Apple are like
B3	We must (show) copyright. [B3: understanding of business/corporate issues]
G2	Yeah it is (inaudible). We need something unique.
B3	We need something unique, so it could be a leaf because leaves are green. [B3: linking colour with suggested image]
G2	I feel like you could put like a plug as an image and then put a x6 next to it. [G2: possible image 2 for logo]
B3	What?
G2	Because it's like ((gestures to the worksheet)) (inaudible) that's six
B3	Yeah, six USB ports. [G2 and B3: linking image 2 logo idea to product]

23.30–25.37

B3	A leaf [B3: reiterating possible image 1]
T	((with group)) A leaf?
B3	But a leaf is eco-friendly [B3: rationale for possible image 1]
G2	But the thing is that our ...
B3	... like for the world, for nature.
G2	But no one's going to know that [G2: not convinced by rationale for possible image 1]
B3	But for nature, it's for nature.
T	Oh ok, so we've got a good argument here going on. We've got someone saying 'a leaf is associated with nature and potentially environmental friendliness' and you're saying 'it's not ...' [T: highlighting productive discussion through critiquing students' ideas]
G3	Yeah because like you wouldn't know what it was (inaudible)
G2	Like if you just go past a sort of leaf you could just think it's like a nature reserve or something.
B3	And when Huawei were probably making their logo they were 'but nobody's going to think of this' but now everybody knows it. They're going to learn about that. [B3: counter-argument: linking knowledge of other logos]

T	So your counter argument here is that that Huawei logo is nothing to do with technology, but people recognise it now?
B3	Yeah.
G2	I don't recognise it.
B3	Well most people do though.
G2	I wouldn't see that sign and think 'oh, it's that brand'.
B3	I would.
T	Well there's no right or wrong here is there? You're both right. [T: reinforcing it is acceptable to have different but equally plausible responses]
G3	Well (inaudible)
B3	((To G2)) What would you do? [B3: asking for other suggestions, following ground rules]
G2	I wouldn't do a leaf. I'd do something that represented energy saving, like putting all the colours into it.
B3	Yeah, a multi-coloured leaf
T	Ok, so we've got colours, but what about images then? What images are you going to use?
G2	It would have to like explain what it is but ...
B3	The image could be a leaf ((smiling at T)) [B3: sticking to possible image 1 for logo]
T	But I'm interested in her arguments now. I've heard the leaf idea, which is potentially a good one, but what are your thoughts as an alternative suggestion?
G2	Even, even just a tree makes more sense though. [G2: expanding on possible image 1 to suggest possible image 3]
T	Ah.
B3	(inaudible) a tree. A tree that's green, orange and red. [B3: embedding possible image 3 with colours]
G2	That's actually – you could do that, green, orange and red barked trees – that's really good. [G2: affirming group membership]
B3	No, green, orange and red leaves on the trees.
G2	Ok.
B3	You see, I'm full of good ideas.
G2	Um, I just thought of that idea. [G2 and B3: joint ideas, contested ownership]

30.20-30.25

B3	I'm still going to do my leaf because it's my own idea. You can do the tree. [B3: sticking to idea 1: argument around ownership]
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37.60–38.29

G2	It almost looks like you're promoting that you can charge straight from the leaf.
B3	What?
G2	((Laughs)) It makes it look like you're promoting that you can like go put your phone on the leaf and it will charge. [G2: playful interpretation of possible image 1]
B3	Ah, I can. It could be a wireless charging base.
G2	Oh yeah it could be. [B3 and G2: building on playful interpretation to innovate design and technical capability]
B3	Because our company isn't – you know, if this was a company – it won't just sell these, it has to sell something different. [B3 and G2: linking process to world of work]
G2	You sound so posh, like you're actually making a company.

5.2.4 Analysis

In this extended Extract, group members switch between individual and group identity or identification, moving between what **'we want'**, expressing that **'we need something unique'**; to stating that **'I'm still going to do my leaf because it's my own idea'**, and **'I just thought of that idea'**. At points the group members seem polarised in their views, with B3 particularly struggling with fixation having thought of the leaf idea, and being perhaps impervious to or unwilling to accommodate G2 and G3's critique or alternatives. B3 draws in examples of existing, successful logos, which on their own are not transparent but become known through familiarisation, to support his position in sticking to his initial idea. In spite of this however there are moments where the students engage with each other's arguments and critique, invite suggestions, to design something together, combined with the teacher's neutral facilitation encouraging them to consider each other's views and offer rationale for their ideas – reaffirming the group's ground rules.

The playful interpretation and discussion between G2 and B3, 'It almost looks like you're promoting that you can charge straight from the leaf', leads the group to consider something none of them had thought of independently – wireless charging. G2 summarised the power of C2C shortly after this extract: 'ours are both great ideas, so putting them together creates one amazing great idea'. It is also evident from the extended Extract how the group make various alignments between their discussion and ideas and the world of work, in embracing the authentic nature of their Virtual Internship – such as reference to **'our company'** in owning their design space, and acknowledging the need to respect 'copyright' and design something 'unique'.

5.3 Example 2: Funnelling ideas/Charging by friction

5.3.1 Participants

As in Extract 1, the class comprised 14 students. The focal group involved one girl and two boys (aged 11-12 years).

5.3.2 Teaching & Learning Focus

With the same class but in a lesson a few weeks earlier, the teacher had introduced the 'global challenge' of climate change, and tasked groups to discuss and identify challenges of local importance and relevance. A different group from Example 1 were considering how to make a bus less harmful in terms of climate change. The group explored creative logistics around an electric bus, and threw ideas between them regarding potential barriers and solutions – some based on existing technology – as demonstrated in the following extended Extract.

5.3.3 Example 2

10.48–15.26

B1	We would need – are we still going to go with the solar thing? [B1: possible solution 1: solar power]
B2	How about wireless energy, because you know how you have wireless energy in Apple and everything? We, can't we just expand that to a bigger size, and it can detect the bus and stop? Bigger solar panels... [B2: possible solution 2: wireless charging, and link to existing product]
	...
G1	We could still do the electric bus but without solar panels.
B2	Yeah, and we could expand the wireless energy even bigger to where it could give out energy for miles. It could be like a (inaudible). It could be a magnet ... [B2: possible solution 3: magnet power]
B1	Why not make one big wind turbine, a humungous one and it shoots energy through two countries? [B1: possible solution 4: wind energy, large scale]
B2	But I think we want magnet power just because in oil power the energy is made by like a huge (inaudible). Can they attach magnets to it, and then you know how like you try to put two magnets together but it stops you and like keeps going another way? [B2: combining possible solution 3 with analogy to oil power]
G1	We've only got 10 more minutes.
T	((joining group)) Right, what have we got guys? Any ideas? What would you need to know?
	...
B2	I was thinking, you know how Apple phones have like wireless energy charging? [B2: linking possible solution 2 to existing successful technology]
T	Right, yeah?
B2	Could you expand that to where it could charge buses within a mile, or like 6 miles?
T	Wow! Ok, so some sort of wireless charging. Put it down. We could investigate that, couldn't we? Yeah ok, keep thinking about that guys. Other ideas please. ((Walking away to another group))
B1	Wireless charging. I still think my idea is the best, to have a humungous wind turbine. [B1: comparing possible solutions]
G1	((To B2)) What did you say?
B2	Wireless charger.
B1	Or we could have something on the roads.
B2	Shorter roads so it uses less energy.
B1	Or we could put something on the tyres and the road. So we could make the road and tyres a specific material so as it drives it makes like friction. [B1, B2 and G1: possible solution 5: reframing the roads, friction power]
G1	We could make it ...
B2	It uses the friction, or the energy from the friction, it uses that to power it along.

B1	Yeah you could do that.
G1	We could make it so that the road charged the bus.
B2	You could run the lines underneath the roads, and you could wirelessly charge the bus.
G1	Yeah, that's what I was saying. ((Writes on worksheet)) Wireless charging from roads to the bus.
B2	You could charge it up (inaudible)]
G1	You could drop your phone (inaudible)
B1	That would be difficult though because if you've got a road, you're probably going to have to dig all of it up to put it under it, but I guess we've got to do all we've got to do to save the planet. [B1: identifying barriers within possible solution 5, but reminding of global challenge]
G1	If you dropped your phone on the road it would go up to 100%. [G1: extra contextual detail from understanding of existing technology – playful interpretation?]
B2	Or just make new roads.

5.3.4 Analysis

Through these discussions it becomes apparent how the group together construct a composite and fairly complex idea: voicing their understandings and challenging their contextualised experiences of current technological capabilities to create something different. Attending to the detail of contributions however, this is not a totally smooth or collaborative endeavour. At the start of the Extract, four different ideas are shared by two group members in relatively quick succession – at this point with neither engaging with the ideas offered by the other. It is the third group member's time-check reminder – a frequent constraint on creative potential and collaborative exploration in the timetabled curricular context – followed by the teacher joining the group ('what have we got?'), that potentially re-focuses the trio on refining their ideas and engaging with each other's suggestions.

As with Example 1, there is some evidence of individual idea ownership ('I was thinking...' by B1 and 'I still think *my idea* is the best' by B2) – which along with the above-mentioned pooling but not interlinking ideas may reflect students' relative newness to groupwork. Notably G1 does not appear to be a validated voice in the discussion until a little way into the Extract, when she seemingly reframes and collates B1 and B2's comments about having 'something on the roads' (B1) and using 'the friction, or the energy from the friction, it uses that to power it along' (B2) by summarising '**We** could make it so that the road charged the bus.' Here the use of 'we', potentially signalling a shared idea and ownership, is arguably significant. Some apparent mixing of ideas or perceived difference is exposed and clarified in the subsequent exchange, as G1 confirms 'Yeah, that's what I was saying. ((Writes on worksheet)) Wireless charging from roads to the bus.'. Interestingly, this interaction and annotated transcription highlights the perceived relative value of spoken and written work in the school context of performance and assessment, as she makes the agreed idea permanent and visible to others by writing it onto the worksheet. Such action is also primed and reinforced by the teacher's comment just before leaving the group to 'put it down' (i.e. write the idea on the worksheet).

During this Extract, group members offer and critique a number of suggestions (though notably some are raised and discarded without further consideration), combine ideas and share understandings to identify barriers and workarounds. As with Example 1, students draw in what they know to resource their thinking about innovative product ideas 'you know how you have wireless energy in Apple and everything? We, can't we just expand that to a bigger size...' Crucially, perhaps after G1's time-check, the ideas 'spark' off each other and develop through the talk between them (to paraphrase Sawyer), including with playful

interaction around what would happen if a phone was dropped on the primed-charging surface under discussion. Toward the end of the Extract, B1 acknowledges the scale of the idea being suggested, but grounds it back in the original challenge to come up with a solution to reduce the impact of climate change: 'I guess we've got to do all we've got to do to save the planet.' Such a reflection arguably evidences that the students in this group acknowledge the authentic nature, urgency, and real-world relevance of their challenge.

5.4 Reflecting on collaborative creativity

The above examples illustrate interactions from the first Iteration of the programme. As indicated in Figure 2, in line with our DBR methodology, it was important to evaluate programme resources and experiences from various angles, to refine and revise for Iteration 2. Alongside analysis of lesson observations, we conducted teacher interviews and a focus group with students. When asked at the end of the programme whether the concept of C2C was useful and meaningful as a teaching tool, the teacher responded:

Oh definitely, yeah. Working together is essential in the workplace, isn't it, and any company that is involved in engineering or design, it's very rare that one person is just responsible for everything. You know, you share ideas, you bounce off each other, and from what I saw from the idea generation with the students, what they came out with was very different to what I'm used to seeing when they only ever work as individuals. It was far more creative, far more varied. Normally you would expect a lot of the same thing, across the group, whereas the class all had different ideas which was nice to see.

Thus it appeared that the rationale behind C2C had come across for the teacher, and been useful in portraying the importance of this to his students. We also asked how he felt the students responded to the concept of C2C, whereby he commented:

I think we spoke about that [C2C] at the beginning, especially with the videos as well. We talked about how important working as a team is, especially in a design process. Perhaps I could have brought that up more often. Things are easily forgotten as time goes on, so perhaps that was floated at the beginning, and probably understood, but maybe a reminder of why we're doing what we're doing would have been a good strategy and is maybe something I'll put into the 2nd rotation.

In considering the teacher's reflection, it is pertinent to note that the example Extracts presented above were taken from lessons early on in the programme. In taking these comments on board when revising resources for Iteration 2, reminders were added throughout the programme stages to 'revisit' the concept of C2C with students, to reinforce its relevance to the current project and beyond. The need for such reminders was reiterated as the teacher reflected, in his post-programme interview, on how C2C was or was not evident in his students' interactions during project lessons – evidencing also the need to make collaborative creativity an explicit and supported dialogic intention:

I think they struggled, and I thought they would. I think it comes down to compromise doesn't it? And everybody has their idea which they treasure, don't they, because it's their idea and therefore they think it's the best. Getting them to take on board other people's ideas is probably quite a big jump for them in terms of maturity. So again, whilst they may not be there yet, something like this project works towards that and helps them have those difficult discussions and come to those difficult compromises without arguing or falling out - hopefully.

... I think there's a lot of almost kind of social skills involved in that, which you wouldn't normally get in an everyday lesson because that scenario doesn't often present itself in anything other than sharing ideas in group work.

Such reflections were mirrored in the students' post-programme focus group, as they commented on the difficulties of working in a group:

Student1: Well that [groupwork] would be hard because everyone in our group has an idea, and everyone wants to have their idea in the project, so it was a little bit hard to point out your idea and to choose another idea from a friend.

Interviewer: So how did you cope with that? What did you do in the end?

Student 1: I just seen what logo is the best for our project, and I just said I couldn't mind because yours is the best choice, it looks much (inaudible) yeah, and it can show, the logo shows what we're doing here and mine doesn't very much.

Student 2: Well when we were doing the bus, we sort of took other people's ideas and just made it all into one logo.

Interviewer: Ok, and that was all right was it? You found that ok?

Student 2: Yeah.

Student 3: Like we all had an idea and we just put it together to make one logo.

Such comments highlight the difficulty these students perceived in combining and critiquing ideas to really work together – with some perhaps conceding to others' ideas, and others perhaps engaging superficially to put all ideas together, rather than engaging and seeking understanding of differences. Of course it should be noted that post-programme data collection relies on teacher and student memory of what happened, which may or may not be accurate. What is likely to be accurate however is how they *felt* about groupwork on reflection, as this is likely to be more personal and prominent than recall of specific details or discussions.

Whilst identifying challenges to collaborative creativity, and the need to structure and revisit how to encourage it in practice, when asked in the post-programme focus group if they had learnt any skills from the project comments included:

Student 2: I think I've learnt better how to work as a team.

Student 1: I've learnt how to work better in a team as well, and I've learnt how to like realistically think about projects and stuff and research.

Such reflections are promising, given that this was a stated aim of the programme, and critical to any development of C2C, and was borne out in some of the interview and observation extracts. From reviewing the data as a whole however, it was clear that more structure and explicit reminders of how to work effectively as a team, and why this is important, were needed throughout the various programme stages. Again as a potential limitation of the method, students could have been responding to this question in line with what they thought the interviewer wanted to hear. However, given their honesty in reflecting on how they found groupwork, it is proposed that this is unlikely.

5.5. Critical Reflections

Interestingly, while the two groups were exploring very different challenges, contexts and technologies, the issues of energy transfer were common with scope for building on and extending common knowledge to create something new and of value. C2C was observable within the groups, though it did not automatically emerge. From post-programme interview and focus group comments it was clear that it was not always comfortable, requiring revisiting and reinforcing in terms of current activities and longer-term relevance. This default to individual efforts and views may reflect students' perceptions of creativity as a solitary activity – which as noted in the literature review is still prominent. It may also reflect that the students were relatively unaccustomed to group work. The strategic intervention of the teacher was therefore crucial, and critically timed for both groups presented here – in reinforcing principles of C2C as a dialogic intention through reminders to listen to a range of ideas from group members, and that there may be different but not necessarily 'right or

wrong' answers. As a broker of the Virtual Internship experience, the teacher did much more than just provide students with access to pre-packaged resources. As a subject expert, he was in a position – and viewed as such by the students – to validate ideas and encourage students to pursue lines of inquiry. With explicit reminders and encouragement, students enthusiastically and sometimes playfully developed collaborative ideas, and worked together respectfully to engage with and build on each other's suggestions. Furthermore, despite the need for roaming between groups, the synergies across groups illustrate the value of teaching C2C at a class level.

Analysing data from a range of sources identified the utility of C2C as a conceptual tool, and its relevance to educational aims and workplace practices. Exploration of the data and different perspectives offered insights from the experiences in Iteration 1, on the basis of which revisions were made for Iteration 2. Revisions included:

- explicit and ongoing reference to the value of collaborative creativity throughout the students' design process;
- creation of a 'student logbook' with worksheet resources and space to log ongoing reflections;
- and guidance to teachers and students on managing difficult negotiations by critiquing ideas without criticising teammates.

The authentic and real-world contexts around which VIP challenges were based were also critical, as students connected their design tasks and their knowledge of workplace practices and conventions. By working with industry experts and teaching professionals through a DBR approach, C2C in the context of VIP offers a grounded and authentic conceptual tool – a 'bridging concept' – representing how meaningful links between education and enterprise can be resourced through explicit attention to what underpins and what could undermine collaborative creativity.

6. Discussion, conclusion and next steps

Collaborating2Create offers a conceptual tool for promoting a classroom culture, where:

- creativity is accepted, promoted and nurtured;
- students feel ownership of creative processes and products in exploring and developing solutions for challenges that are understood, meaningful and important to them;
- and students develop future skills required and valued by the world of work.

The purpose of developing the VIP approach in a small number of lead research schools, through iterative trialling, feedback and refinement, is to create a Virtual Internship model that has a recognisable and replicable foundation and core – supporting development of skills valuable for education and the world of work – but that is adaptable to schools, curricula, and age groups in a variety of contexts, and in partnership with external organisations from multiple disciplines.

This paper particularly focused on one element of this wider work, offering C2C as a conceptual tool to support educational design for promoting potentially creative features within classroom interaction. Of course, and as illustrated in the transcribed examples, it is how these features are taken up by groups, collaboratively and in context, that influences whether such contributions and responses are deemed to be creative or feed creativity. The paper outlined a focussed tool that can help design pedagogy for group creativity, illustrated how this works, and how its 'success' can be encouraged and observed in naturally-occurring classroom interaction. It is argued therefore, as a key contribution of this paper, that C2C offers a useful conceptual tool for teachers wishing to embed group creativity – through understanding what can promote or hinder such patterns within interaction.

Potential limitations of this paper are the small amount of data presented. The purpose of data presentation however was to exemplify what C2C can look like, and how it can be facilitated, rather than making wider generalisations. It is argued therefore that the transparent reporting of conceptual development is useful for researchers wishing to explore such interactions, and for teachers wishing to encourage such practices in their own contexts.

It is also important to acknowledge that data collected and presented in this paper occurred in a pre-COVID context, where students and teachers were physically co-present and working together around tangible resources. The situation in schools globally changed significantly due to COVID, whereby facilitating meaningful groupwork has become far more challenging, but not impossible. In such times of *physical distancing*, tools to support *social connection* are even more important. Whether facilitated online or in person, C2C offers one such tool.

The paper contributes to current knowledge by responding to identified gaps in the literature:

- addressing collaborative creativity as a useful skill for education and in preparation for the world of work, before students have made or ruled out career choices;
- and in offering a structured tool to support teaching for this, developed through rigorous Design-Based Research.

In exploring a specific intersection of collaboration and creativity in terms of pedagogy and educational design, and in working in partnership with colleagues from industry and teaching practice, new insights are offered into the development and instantiation of a conceptual tool to support students' effective collaborative creativity. Going forward, research should explore C2C in contexts of 'social distancing', and how a focus on collaborative creativity can support development of pedagogy and technological infrastructure that enables meaningful social interaction and engagement between education and the world of work. This is an ongoing priority for the research team, and will be a pertinent area of concern for some time as the world adjusts to, and invents, an education system for the post-pandemic society.

Acknowledgements

We are hugely grateful to the schools, teachers and students who participated in VIP, and worked with us to refine the project model and resources.

We also wish to thank our industry colleagues at British Telecom and Huawei who funded this work, supported project development, engaged critically to shape ideas, and recorded stimulating videos to increase the authenticity of the programme.

Funding

This work was funded by British Telecom and Huawei.

Declarations of interest

none

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