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Using design thinking as an approach to creative and communicative engagement in the English as a Foreign Language (EFL) classroom

Tim Cleminson

Kawasaki University of Medical Welfare, Japan, tim@mw.kawasaki-m.ac.jp

Neil Cowie

Okayama University, Japan, ncowie2012@gmail.com

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Abstract

Design thinking (DT) could provide a viable method to develop 21st-century skills in English as Foreign Language (EFL) classrooms; however, its potential is not clearly understood. To explore this potential, two Japanese university teachers developed a DT course in which students built a creativity measure and wrote academic reflections. Student work displayed creative thinking, insight, and language play. Survey data revealed correlations between DT, student enjoyment, confidence communicating, and thinking flexibly. In conclusion, DT can facilitate collaborative engagement and creative thinking, however, time to develop on-task communication and a focused approach to report writing may be necessary to support understanding and communicative competence.

Keywords

design thinking, English as a Foreign Language, EFL, creativity, engagement, Japanese university students

Introduction

Why creativity matters

The need to find solutions to complex problems in an interconnected world has increased the importance of twenty-first century skills (OECD, 2017; World Bank, 2019; World Economic Forum, 2016), the development of which should be essential goals for universities. However, research has questioned their ability to do this (Harmon, 2017; Robinson, 2011). Although there are a range of paradigms for twenty-first century skills within education (Kaufman, 2013; Prensky, 2012; Wagner, 2006), they share a focus on analyzing a problem, understanding it from different perspectives, and collaboratively finding a suitable solution (Scott, 2015). To understand a complex problem requires the cognitive flexibility to analyse it from different perspectives and in order to find a suitable solution requires creativity to synthesize the variables in the problem and generate workable ideas. Hence, collaborative projects that require creativity are likely to facilitate the use of a wide range of twenty-first century skills.

In our research, we look at whether “Design Thinking” (DT) activities in the English as a Foreign Language (EFL) classroom can deepen student understanding of creativity and facilitate using twenty-first century skills. In DT, design teams create solutions based on an empathetic understanding of end users (Brown, 2008). Hence, in principle, it provides a working process that can facilitate communication and creative collaboration. In this article, we describe how we implemented DT in the EFL classroom, the type of learning environment and student engagement it facilitated, and the learning outcomes and knowledge it generated. Finally, we review the implications of our findings for future course development.

Definition of creativity

In the following sections, we will first outline the key characteristics of creativity in general using a common division into product, process, person and press. Then we will show how creativity has been used in the EFL classroom to develop creative, critical and communicative skills.

Creativity is an abstract notion that appears difficult to define clearly (Batey, 2012; Ellis, 2016; Mullet, Willerson, Lamb & Kettler, 2016), however it is essentially social in nature. In order for solutions to be judged as “creative”, they should be considered “new, surprising and valuable” (Boden 2004). Creative solutions that are novel ways to solve a localized problem are described as creativity with a little “c” (Csikszentmihalyi, 1990). Although they may not be revolutionary, these ideas are practically and psychologically important for the creator and their local community. In order to analyse and understand creativity better, researchers have suggested it is useful to break the concept down into more distinct and concrete ideas such as the 4 P’s, i.e. creative *product*, *person*, *process* and *press* (environment) (Densky, 2016; Ellis, 2016; Rhodes, 1961). Perhaps the easiest aspect of creativity to visualise is the *product*, i.e. the end result. A new invention or solution needs to be judged as novel and effective by a community to be considered creative. Furthermore, as there have been many famous inventors and artists, the creative *person* is generally easy to visualise. When we consider the creative person, we should include their knowledge, skills and innate abilities, as well as their cultural assumptions about tradition and innovation and the way in which they value creativity. For example, in some cultures novelty may not be valued as highly as appropriateness, or getting the right answer (Densky, 2016; Niu & Sternberg, 2006).

The *creative process* can be considered as a set of behaviours that involve combining ideas in innovative ways, exploring conceptual spaces, and, potentially, transforming them (Boden, 2004). In the creative process, imaginative and critical skills are complementary and follow patterns of divergent and convergent thinking (Guilford, 1957). Divergent thinking is the use of imagination to

open up conceptual space and generate potential solutions to a problem. On the other hand, convergent thinking is the application of logical conditions and systemized thought to choose the most suitable solutions and make them fit for purpose. The iteration of divergent and convergent thinking in relation to a problem allows innovative and valued solutions to be generated. In addition, because creative work has a clear purpose and a measurable result, the process has meaning and can produce positive affective states of focus, contentment and “creative flow” for individuals (Csikszentmihalyi, 1990) and groups (Sawyer, 2007). The *creative press* highlights how people experience the environment in which they create. How individuals engage with the environment during the creative process is not incidental to the nature of the products they create (Rhodes, 1961). Accordingly, the pedagogies used in the EFL classroom are likely to affect not only the products students develop, but modes of communication and the psychological effects of the creative process. Therefore, finding an effective method of teaching creativity is essential to maximizing its benefits. Now let us review the relationship between language and creativity and how creativity has been employed in the EFL classroom.

Creativity in language and the EFL classroom

As Jones (2016) highlights, creativity in language is not solely a literary concept about using formal language in artistic ways, it can also be applied to everyday language use, and creative action in our daily lives. Indeed, language facilitates creativity because it is both rule governed and ambiguous, and socially situated and dialogic (Jones, 2016). These attributes enable not only meaningful innovation within an established practice but also playful reading between the lines. Creative linguistic innovations and humorous phrases are memorable and aid understanding and information retention (Bailey & Krishnan, 2016; Tagg, 2013). Moreover, language is socially situated and dialogic and requires empathy and imagination to interpret others and bridge gaps of understanding in everyday conversation (Chappell 2016). Reflexivity, empathy and social-emotional imagination allow us to visualize different perspectives and future selves, think creatively, and communicate appropriately (Gotlieb, Jahner, Immordino-Yang & Kaufman, 2016). Hence, we should see creativity not only as an artistic process but also as a fundamental part of communication, facilitating memory, collaboration, and call and response dynamics.

Creativity research in the EFL classroom has focused on both the creative product and process. For example, creativity in EFL research has often aimed to enrich language use through artistic activities such as drawing, dramatized texts (Dervishaj & Xhillari, 2014), creative writing (Dougherty & Dougherty, 2008), digital presentations (Hafner, 2014), and multilingual texts (Choi, 2016). These pedagogic approaches focus on how language can be used in the generation of a creative product. These “products” can be artistic; however, they may be factual presentations or even attempts to find practical solutions to real world problems. In addition, research has focused not only on the product but also what the product means to those who create it, how creativity can change our conceptions of language, and how the process of creation affects student motivation.

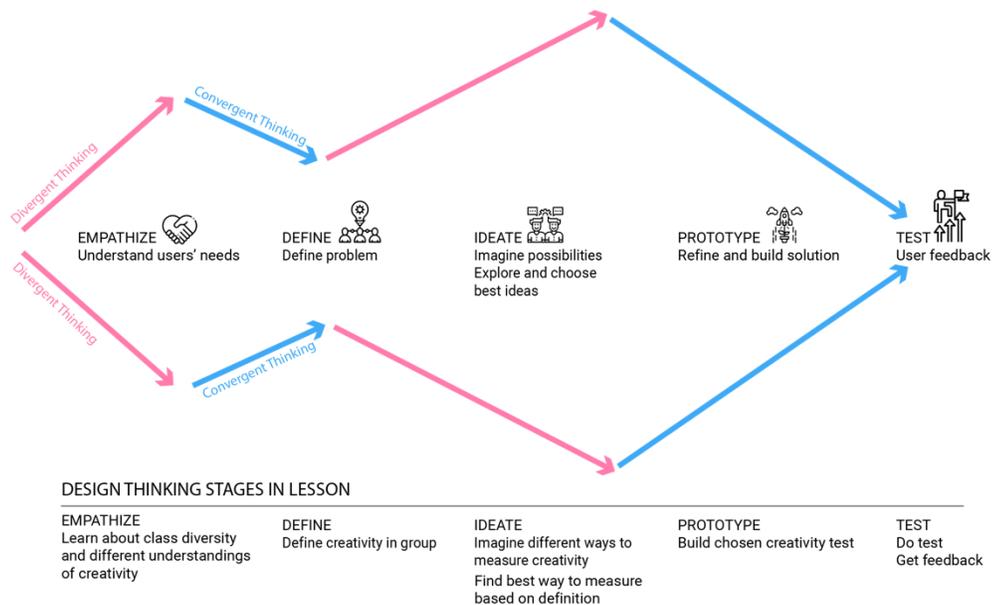
Problem-based language learning requires a creative response and exemplifies Dewey’s conception of learning emerging from purposeful action (Dewey, 2004). Interaction and negotiation during problem solving facilitates close listening (Kobayashi, 2003) and can develop fluency and linguistic complexity (Skehan, 2003). The student-centered and applied nature of the tasks is also seen as motivating and meaningful (Apple & Kikuchi, 2007), and beneficial in creating long-term knowledge retention (Boothe, Caspary & Wickstrom, 2017). Collaborative work can help develop criticality and the use of creative communication strategies as part of the problem-solving process (Bailey & Krishnan, 2016; Densky, 2016; Tin, 2013). Given these dynamics, collaborative project work in the EFL classroom has the potential to develop an engaging learning environment that nurtures English production. In the following section, we will outline why DT could be an effective

way to frame existing approaches that incorporate creative production in a process that enables collaborative interaction and communication and helps nurture twenty-first century skills.

Why Design Thinking (DT)?

DT aims to create innovative solutions to real world problems that are valued by the end user (Brown, 2008). As can be seen in Figure 1, the first stages in the DT process are to *empathize* in order to *define* the problem in context (Stanford d.school, 2010). In order to do this, the design team conducts empathetic interviews to understand how end users see the problem. Based on this understanding the design team then creates a range of possible solutions during the *Ideation* stage. During ideation, initially divergent thinking is encouraged. When a critical mass of ideas has been created, teams select the most promising ideas and evaluate their practicality by thinking more critically about how they would be applied. During the latter stages of the ideation process, increasingly convergent forms of thinking are employed. Through small-scale development, experimentation and reflection teams learn which designs are most suitable for solving the problem. When a team has agreed upon the most suitable solutions, they enter the *Prototype* stage and create working prototypes of the product. During the *Test* stage, the prototype is tested and changes are made based on feedback to make sure the solution is fit for purpose.

Figure 1



Design Thinking approach to design and problem solving (Stanford d.school 2010)

The centrality of creative action and dialogue suggests DT could be a suitable form of *creative press* that facilitates English communication and the development of twenty-first century skills. The entire process is based on deep listening and adaptive communication in an applied context (Kobayashi, 2003). Problem definition requires social-emotional imagination (Gotlieb et al, 2016) and cognitive flexibility to see different perspectives. Ideation requires the creative use of divergent and convergent thinking. During divergent thinking students must employ communication techniques that open up space to facilitate the sharing of unconventional and experimental ideas. This can be achieved by initially affirming other team members' ideas, rather than challenging their suitability

on rational grounds. In contrast, during convergent thinking students must use rational grounds to close-down space and argue for what they feel is the best group decision. Rather than being predefined by the teacher, knowledge and learning outcomes emerge from the problem-solving process (Boothe et al, 2017). DT's emphasis on team action and student autonomy creates a constructivist and motivating learning environment (Scheer, Noweski & Meinel, 2012). Increased student control of learning tasks and group work facilitates purposeful inter-learner interaction (Skehan, 2003) and scaffolded learning (Vygotsky, 1978). As designs must be fit for purpose, this may make DT suitable for EFL classrooms in countries where appropriateness is valued over novelty (Niu & Sternberg, 2006). Finally, the emergent goal-oriented nature could facilitate positive affective states and feelings of creative flow in the classroom setting (Csikszentmihalyi, 1990; Sawyer, 2007).

In theory at least, DT provides dynamic student-led activities that can facilitate creative language use and the development of twenty-first century skills. However, the question remains how DT activities actually operate in practice. There may be cultural considerations that affect how best to implement the creative process, especially in countries that generally have a greater emphasis on teacher-led, structured learning, such as Japan (Cowie, 2006; Densky, 2016). As this is an under-researched area, there is a need to understand the best way to implement DT-based EFL courses in Japanese universities. Accordingly, this article will describe one DT course in detail and try to answer the following two exploratory questions:

1. What kind of knowledge and learning outcomes emerged from the course?
2. What are the implications for course and materials design in implementing a DT course for EFL students?

In order to address these questions, the researchers present the course they created and the experiences of both students and teachers as a case study for review.

Course context and general approach

This eight-week writing course took place between April and June 2018 in a Japanese university "academic topics and tasks" English class. The students were all second years from four faculties. Their average TOEIC score on entry was 466 (this score corresponds to a high A2 on the CEFR scale or a "basic user"). One of the aims of the general English program is to develop skills for advanced report writing and the writing up of research. However, these are challenging in an EFL environment, especially with non-advanced groups. Therefore, in order to motivate and focus students, the teachers decided to develop a course that combined experiential activities with reflection and writing up exercises.

The course should be best considered as a form of "DT-Lite" as it introduces the basic concepts and processes of DT, without requiring the investment of time and energy of a full DT project. The classes took place twice a week (Tuesday and Friday); each lesson was two hours long with a ten-minute break in the middle. The students received separate grades for experiential and report writing activities. The first author, Tim, introduced experiential activities and lessons on creativity in Tuesday's lesson. In the Friday lesson the second author, Neil, focused on academic writing using the activity classes as the basis for two reports. The experiential activities and report writing were divided into two sections: (i) personal identity and learning styles; and, (ii) the creative process and design thinking.

Experiential collaborative classes

In the Tuesday lessons taught by Tim the students were first required to explore how they learn and interact with others. Students took photographic portraits as a creative ice-breaker. Then students

were introduced to different types of learning, such as visual, kinesthetic and aural. They combined their portrait and preferred learning styles in a learning map “profile”. Finally, students measured their preferred personal space when speaking with others and compared the results. These experiential activities were designed to make students aware of cognitive and communicative diversity in the classroom and develop social relationships.

Subsequently, the concept of creativity and some creativity tests were introduced. The main purpose of the introduction was to challenge the notion that creativity is purely artistic and something done by famous artists or lone geniuses. Creativity was introduced as a concrete process that anyone can take part in by combining different ways of thinking to problem solve. Accordingly, students did short activities to learn about divergent and convergent thinking and how they are used in DT. They then took established creativity tests created by researchers such as Guilford (1957; 1959) and Torrance (1981), and discussed their effectiveness. Tim explained some activities in L1 to make sure students understood key concepts. Whereas convergent thinking activities progressed smoothly, divergent thinking tests often took longer than expected as students wanted to verify the context and details before making suggestions. Finally, the students were put into teams and had two weeks to create a test that measures creativity. The test and instructions were made in English. In the final lesson, the whole class took the tests and gave feedback. The teachers hoped that applying the new ideas about creativity in a purposeful activity would generate deeper engagement between students and facilitate creative thinking.

Writing lessons

In the Friday writing lessons, Neil’s main purpose was to guide the students to write two short academic reports (600-800 words) about the ideas and concepts that Tim introduced in his lessons. For example, in report one, students wrote about their personal background, learning style and personal space. Report two was about their view of creativity, and making and evaluating a creativity test. It was hoped that the Friday writing lessons would provide an opportunity for students to reflect on the activities introduced on Tuesday. Neil encouraged the students to review what they had learned and work together to clarify and consolidate their thinking. In addition to reviewing Tim’s main points, Neil also provided input in terms of “academic writing” conventions (overall organisation, transitions, support and details, references and so on). Much of the class time was given over for students to write. All had lap-top computers and spent an hour out of the two-hour lesson writing. During this time students could talk with their friends or work independently and Neil would monitor and advise individual students.

Methodology

The theoretical framework used in this article is that of “exploratory practice” (Allwright, 2003) in which data from the classroom is used to inform future practice. Such classroom data included student surveys, learning journals, written reports and the creativity tests the students made. In addition, there are teacher observation notes and discussions with students about the course. This data was analysed inductively by the two authors to find common themes and categories as well as promising outlier information (Manning & Cullum-Swann, 1994). Participation in the research was voluntary. The nature of the research and how the resulting information would be collected, analysed, used and managed post-research was explained to the participants in verbal and written format. Based on this understanding, students gave their written permission for participation.

Results

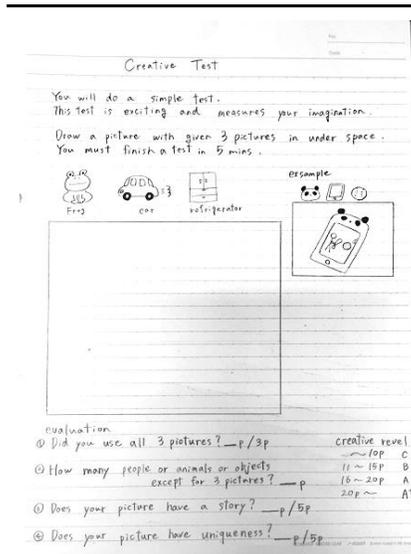
The results are divided into five sections: student creativity tests and written reports; an overall analysis of survey data about creativity and affect; significant correlations that emerged from the survey data; and a brief listing of outlier results.

Student creativity tests

Firstly, we will describe the tests that the students made and how these tests exemplified student understanding of the creative process. Students worked in groups to make the creativity tests following the DT process by thinking about possible solutions, discussing their merits, choosing the most suitable and then making it fit for purpose. Ideally in an EFL class, students would conduct discussions using only English. However, students code-switched between English and Japanese based on the complexity of the issues, often using their L1 when discussions became complex or opinions differed greatly on a topic.

Students made a variety of innovative creativity tests that focused on visual, linguistic and narrative imagination, as well as critical thinking. Groups had to create the test and also write the instructions for the test in English. Most tests involved forms of divergent thinking but many also incorporated aspects of convergent thinking (Guilford, 1957). The suitability and quality of the tests showed the students understood the core aspects of the creative process well. Many of the tests were innovative and some were multimodal. As can be seen in Test 1, many tests required students to be playful with language such as using unusual grammatical structures as starting points for creativity. Three of the tests are briefly introduced below for readers to get a sense of the way the students synthesized the ideas of creativity presented in class:

| | |
|--|---|
| <p>Test 1: Imagine and draw We will give you two or three grammar patterns You must imagine something based on these patterns. Draw or write what you imagine.</p> <p>For example, 1. Noun + Noun e.g. party-cat 2. Noun + Noun + Noun e.g. party-cat-mountain 3. Adjective + Noun e.g. exciting ice cream 4. Adjective + Noun + Noun e.g. unusual January hair</p> | <p>Description and analysis This test is a creative exploration of English grammar that requires participants to create new compound nouns. Although there is a basic structure, participants use divergent thinking to create a variety of new words and phrases. Participants can either use words or pictures. The evaluation system for this test is to identify the answer in the group that is the most original. Hence, the main emphasis of this creativity test is divergent thinking.</p> <p>Scoring is decided in the group. The group must decide which answer is the most original.</p> |
| <p>Test 2: Imagination test</p> | <p>Description and analysis The basic premise and scoring system of this creativity test is based on the Torrance creativity test (1981). Participants must use the visual prompts to complete a picture based on their imagination. The scoring contains divergent thinking concepts such as fluency, i.e. how many objects are used; and originality, i.e. how unique is the picture.</p> |



The students also include convergent thinking in requiring the picture to have some narrative structure and to make sense. The students making this test have used their imagination and reasoning to create a balanced test. This test is simple to understand and has combined elements to test both convergent and divergent thinking in a visual context.

Test 3: Guessing the rule

Q1 Guess the Rule

There is a *relationship* between the *numbers* and the *letters*.

733=bee 653 = age

HINT: ♪♪♪♪♪

Please guess it, and fill in the following blanks. You have 3 minutes to guess.

1643=___ __ _ ?

Q2 Use the letters in Q1.

Combine them to make new words.

You can use them again and again.

Please make meaningful words.

(You have 2 minutes to write)

Description and analysis

The students focused on testing logical thinking skills. This is a code-breaking puzzle based on a number and letter series, e.g. “733=bee”. A visual hint is included, “♪♪♪♪♪”. Participants guess the relationship, then use the cipher to write the word that corresponds to “1643”. The cipher is based on the musical scale from C to B. “C” is “1”, “D” is “2”, “E” is “3”, and so on. Hence, “1643” is “Café”.

In stage two, participants have two minutes to create as many words as possible using these seven letters. This test mainly utilizes convergent thinking because it involves the creative application of rule governed requirements, i.e. there are limitations on the permissible letters.

Written reports

As well as developing creativity tests the students wrote two reports, the second of which focused on their definitions of creativity and their reflection on the creativity tests. An analysis of the second report shows three broad categories of insight from the students: i) their general definitions of creativity; ii) examples of what students believed were “creative people”; and, iii) strategic ways in which creativity could be achieved. Each of these is now examined in turn, although there is considerable overlap between each theme. Where appropriate, examples from the student writing will be used to illustrate particular points.

General definition of creativity

The first category of comments were brief definitions of what the students thought creativity was. Just over half of the students included a specific definition of creativity. The definitions taken as a whole focus on how creative behaviours lead to innovation. Key elements were: creativity means making something new (being unique, original and inventive); it involves using your imagination; it requires being flexible and choosing from a range of ideas; it means taking action or making an effort. These aspects reflect conventional notions of creativity and aspects of the DT process such as being flexible and choosing from a range of ideas.

Examples of creative people

The second and largest category of comments were examples of creative people. Virtually all students did this compared to only about half being able to give a definition of creativity. It would seem that giving a definition is not as easy as giving an example. These examples were divided into two types: generic types such as writers and composers and more specific examples of creative people such as Steve Jobs or “my mother”.

Firstly, there were 13 examples of generic creative types, the majority of which were “traditional” creative types such as writers, composers and painters. One example of a more modern creative role was that of game scenario writer. The remaining examples were those of more prosaic jobs including teachers, chefs, and scientists.

Rentaro stated that chefs show their creativity when they combine dishes from established ones.

Chisa, who is a painter herself, said that painters and writers use their imagination to create a fantasy world.

Secondly, there were many more examples of specific creative people. The most commonly mentioned individual was Steve Jobs (five times). Other famous celebrities, singers; sports people and historical figures were also mentioned. Interestingly the vast majority of examples were people close to the students’ lives such as their family (brother, father, mother, cousins), friends, and teachers. The most frequently mentioned were fellow club members, either from high school or university. Such clubs included brass band, drama, dance, lacrosse and calligraphy. Hence, the students referenced little “c”, or everyday creativity, in their characterisations (Csikszentmihalyi, 1990).

Referencing specific people enabled the description of creative personality traits and behaviours. These included not only unconventionality but also being open to ideas and the need to focus and make an effort over time:

Umi believes that Steve Jobs was innovative, unconventional and ingenious which led to him having new and original ideas.

For Shunsuke’s example, YouTuber ‘Tokai on air’, being creative is a necessity and ‘close to crazy’.

Kiyo’s drama club peer is open to many other ideas, can take action and use his imagination.

Sayaka says that ukiyoe artist Hokusai continued to draw every day into his 80s and as he was not satisfied he kept making efforts and wanted to do something new.

Mari’s lacrosse team mate practices on her own, watches videos and has a passion, and her effort is really important.

Aspects of the DT process were also referenced in these descriptions, especially the power of collaboration, combining divergent ideas and learning through interaction with others:

Nobuyo's dance club members work in a team, have different ways of thinking and can be creative by combining their different ideas.

Rie's calligraphy club mates have many divergent ideas and create new models in a collaborative process.

Creative strategies

In the third category of comments, a small number of students described various strategies that could be used to promote creativity. Examples include writing down ideas, collecting information, brainstorming and collaborating:

Hizuki believes that creativity is the skill to produce something new. You can encourage this by encouraging questions rather than correct answers, not worrying about failure and making effort.

In sum, it can be said that although it was challenging for students to write a definition of creativity they did identify a number of common elements. These were that creativity means using your imagination to take action and make something new. Students' often expressed their understanding of creativity by describing generic creative types and people known to the students. Interestingly, they had close personal knowledge of a creative person such as a club mate and described everyday creativity. When writing about creativity the students could draw upon specific actions or strategies that these role models for creativity used in their creative process. Students referenced individual personality traits and the need to make an effort over time. They also referenced key aspects of the DT process such as the power of collaboration, being flexible, and using imagination to create ideas and choose from a range of ideas.

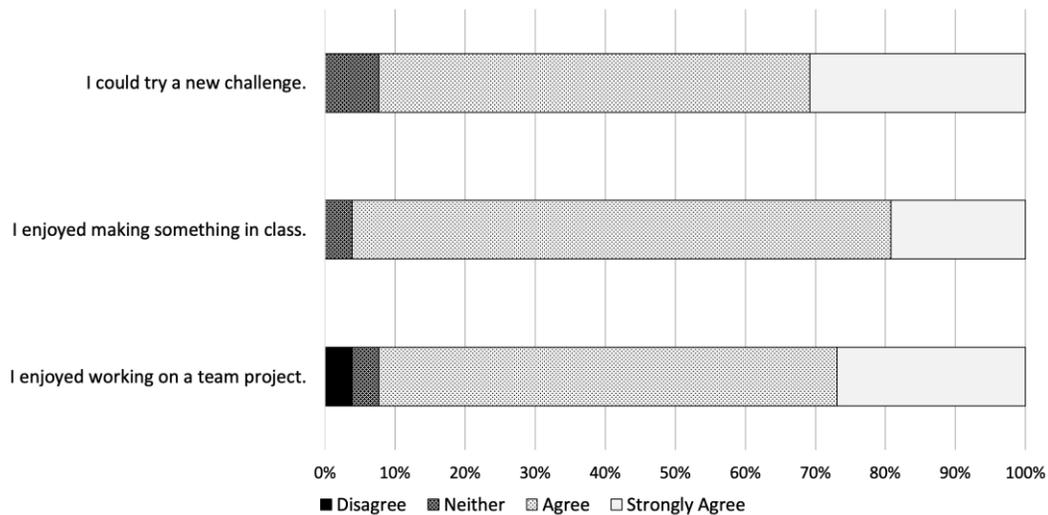
Survey results

Having discussed the creativity tests and written reports we would now like to describe the survey results regarding how students viewed the DT process and their affective responses to the learning environment.

A bilingual survey was conducted to measure affective responses to activities and skill development. Students were asked to express their level of agreement with statements relating to their communicative competence, their ability to think and enjoyment of the tasks. Agreement was expressed on a 5-point Likert scale ranging from "Strongly Agree" to "Strongly Disagree". Students were also asked how often they felt a range of positive and negative states such as "Apathy" and "Excitement" during the learning activities. In the activity classes, there were 26 valid responses.

In general, the vast majority of students had a positive response to the experiential activities and participating in DT activities. Over 90% of the students enjoyed working in teams, making something in the class, and felt they could engage with a new challenge on the course (Figure 2).

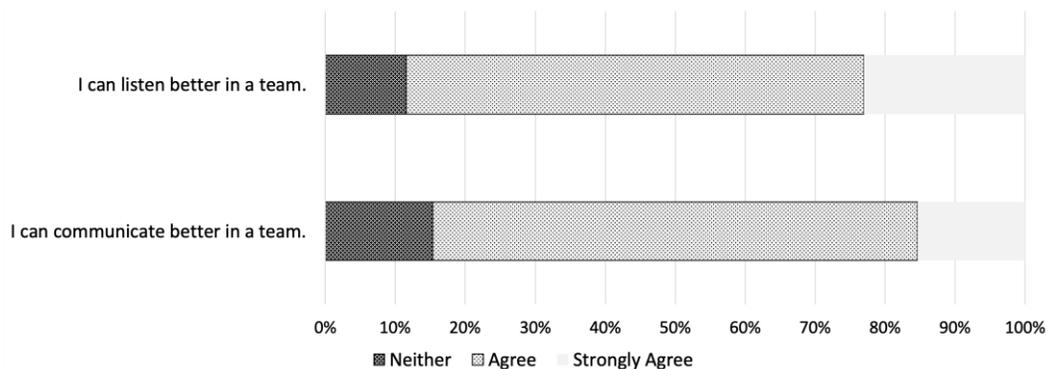
Figure 2



Students' affective responses to DT activities

Around 90% of students thought they had learnt to listen better, and 85% thought they could communicate better in a team (Figure 3). These results show that students engaged positively with the team based creative activities and felt their communicative performance and understanding had improved over the course.

Figure 3



Student perceptions of communication and listening skill development

Correlation analysis

In order to understand these responses better, a Pearson (2-tailed) correlation analysis was carried out using IBM SPSS for Statistics (Ver.20). As there were 26 responses in the activity course, a coefficient of $r > 0.40$ with a significance value of $p < 0.05$ was judged to be indicative of a statistically valid correlation. Due to the small sample size, these statistics should be considered as exploratory in nature, and as indicating areas suitable for follow-up research.

Affective responses to the DT approach

Overall, students' affective responses to a DT approach were positive, especially when making something in the class. Table 1 shows that there was a moderate negative correlation between feelings of apathy, worry and stress and enjoying team projects and making activities. Additionally, understanding the aim of activities, enjoying team work and making activities were all correlated with student interest. However, only enjoying making activities was moderately correlated with deeper levels of engagement such as excitement ($r=0.487$, $p<0.05$) and absorption ($r=0.406$, $p<0.05$). These results suggest that team-based projects with clear aims negate feelings of apathy and stress, and raise interest among students. In addition, making activities may have a relationship with deeper feelings of focus and engagement.

Table 1

Correlation between affective states, flow states and enjoyment in teams, making activities and understanding the aim of the activity

| Activity Component | Affective Response and Flow State | | | | | |
|---|-----------------------------------|---------|---------|----------|------------|------------|
| | Apathy | Worry | Stress | Interest | Excitement | Absorption |
| I enjoyed working on a team project. | -.673** | -.560** | -.663** | .412* | .335 | .205 |
| I enjoyed making something in class. | -.507** | -.443* | -.496* | .452* | .487* | .406* |
| I understood the aims of the activities | -.431* | -.391* | -.321 | .432* | .251 | .313 |

(** = $p<0.01$, * = $p<0.05$)

Students enjoyed the collaborative DT activities and felt they helped them to think more deeply and flexibly. As can be seen in Table 2, thinking deeply was moderately correlated with enjoying team projects ($r=0.615$, $p<0.01$), making something in class ($r=0.636$, $p<0.01$) and feeling a sense of challenge ($r=0.652$, $p<0.01$). Thinking flexibly had a moderate correlation with enjoyment in team projects ($r=0.524$, $p<0.01$) and making something in class ($r=0.457$, $p<0.05$). This suggests that collaborative creativity and problem-solving during ideation and prototyping creates an environment that may facilitate thinking deeply and flexibly.

It is possible the sense of challenge and focus in purposeful team projects creates an environment in which communication becomes meaningful. For example, as can be seen in Table 2, feeling an improvement in team communication skills was strongly correlated with making something ($r=0.762$, $p<0.01$), and moderately correlated with enjoying team projects ($r=0.629$, $p<0.01$) and a sense of challenge ($r=0.602$, $p<0.01$). There was also a strong correlation between improvement in listening during teamwork and a sense of challenge ($r=0.846$, $p<0.01$). This could suggest that the need to create solutions to complex problems within a team makes group members more attentive when others are speaking. Overall, these correlations suggest the DT activities helped students feel more confident about their communicative skill and cognitive flexibility.

Table 2

Correlation between DT activities, student enjoyment and affective responses to communicative competence and cognitive flexibility

| Activity, Cognitive and Communication Component | Activity Component | | |
|---|--------------------------------------|--------------------------------------|------------------------------|
| | I enjoyed working on a team project. | I enjoyed making something in class. | I could try a new challenge. |
| I enjoyed working on a team project. | | .815** | .715** |
| I enjoyed making something in class. | | | .745** |
| The activities made me think deeply | .615** | .636** | .652** |
| I can think more flexibly about a problem | .636** | .457* | 0.361 |
| I can communicate better in a team | .629** | .762** | .602** |
| I can listen better during teamwork | .659** | .665** | .846** |

(** = $p < 0.01$, * = $p < 0.05$)

In sum, these correlations show that students engaged with the DT activities and had positive affective responses. Students felt the group DT activities made them think deeply and more flexibly about problems and also improved their listening and communication skills. This suggests DT activities facilitate collaboration, communication and cognitive flexibility.

Outlier voices

Although there was a positive response to the activities, students also made comments about how the course could be improved in the future. Some students wanted a more detailed explanation of the creative process and more opportunities to analyse pre-existing tests before making their own. One student also intimated that their group copied an existing test that they had found on the internet instead of creating their own test. This shows a concern with creating an appropriate response, rather than exploring ideas freely. As these were often complex ideas, more time and support was needed by some students to understand the DT process. Although the tests were multimodal, some students said they wanted to use their hands more and have more active and kinesthetic ways to be creative. Students also suggested that it was difficult to build constructive working relationships with students in a short time when the group members were not friends. Hence, although the majority of students

engaged positively with DT process, some students may need more time and support to work effectively.

Discussion

In the following section, we would like to return to discuss our two initial exploratory questions.

What kind of knowledge and learning outcomes emerged from the course?

In order to discuss the learning outcomes and knowledge that were enabled in the DT we can consider the products the students produced (the tests and reports) and their affective responses to the course.

Firstly, the tests required students to create products in English, and think about English in a critical and creative way. Writing the tests and instructions gave students experience of creating a product in English and getting feedback from users. Many of the tests focused on using language in unconventional ways. Students were playful with English, using unusual grammatical structures, or unusual combinations of objects and adjectives as starting points for creativity. This required thinking critically about language structure and thinking flexibly to apply that understanding in a new context. Hence, it could be argued that making the creativity tests helped students read between the lines of conventional English and play with the rules of language (Jones, 2016), to make something new, memorable or entertaining (Bailey & Krishnan, 2016).

The suitability and quality of the tests show that students understood the creative process and applied their understanding to generate “new, surprising and valuable” (Boden, 2004) solutions to a localized problem. Hence, the tests were examples of little “c” creativity (Csikszentmihalyi, 1990). Tests were multimodal, combining words, ideas and images in novel and effective ways (Bailey & Krishnan 2016). Through iterations of divergent and convergent thinking students synthesized a range of variables to generate workable tests (Guilford, 1957) and learning outcomes emerged from the problem-solving process (Boothe et al, 2017). The requirement for designs to be fit for purpose may be suitable for the classrooms in which there is a greater focus on appropriateness within creativity (Niu & Sternberg 2006). In making the creativity tests, students were simultaneously gaining valuable experience of collaborating on a creative task. It is possible that the experience of learning about creativity whilst being creative may have facilitated deeper reflection on the creative process in report writing.

Even though the students’ English level was classified as “basic”, the quality and depth of reflection in the reports were high. We do not have an independent measure of this quality but, having taught academic writing for over 20 years, Neil could see that the reports were impressive given the limited time that students had to write them. It is a subjective impression but it may be that the experiential activities and DT activities were more engaging than other typical “academic” fare and that the students responded very positively to it. Although creativity was not described in terms of person, product and process in the class (Densky, 2016), students often characterized creativity using these ideas in their reports. Therefore, this is some limited evidence that this model may be an effective way to organize what emerges if you ask people to discuss creativity. Students often drew on the actions and strategies of creative role models they knew for examples of little “c” creativity (Csikszentmihalyi, 1990). When students gave a definition for creativity or described the creative process, they referenced the power of collaboration, being flexible, and using your imagination to create something new from a range of ideas. It is interesting that when students had to think more abstractly about the process, they could utilise aspects of the DT lexis. This suggests the experiential activities helped students acquire new vocabulary and that they increased their linguistic command in describing the new topic of creativity.

Finally, survey results suggest DT's emphasis on team action and student autonomy creates a constructivist and motivating learning environment (Scheer et al, 2012). During ideation and prototyping, students had to imagine possibilities, communicate their ideas and create collaboratively. Close listening and communication are essential for success in team challenges (Kobayashi, 2003) and students felt their ability in both improved during the course. Enjoyment working in teams and making the tests correlated with thinking more flexibly and thinking deeply. This correlation could suggest the social and discursive nature of collaborative problem-solving facilitated inter-learner interaction (Skehan, 2003) and scaffolded learning (Vygotsky, 1978). Teamwork correlated with feeling interested in class, whereas making activities correlated with feelings of excitement and absorption. These findings support the notion that when students have control over meaningful challenges that require a creative response, it can be motivating (Richards, 2013), and can promote psychological well-being and flow states (Csikszentmihalyi, 1990; Sawyer, 2007).

What are the implications for course and materials design in implementing a DT course for EFL students?

Although students engaged positively with the DT process, there are still concerns about how these materials can be optimised for the EFL classroom. One of the key issues is developing students' communicative competence to engage in on-task communication during the design process. Students were motivated by the design tasks and animated in discussions. However, even though students were given time to practice on-task conversation strategies, the complexity of the design tasks led to students communicating in both L1 and L2. Accordingly, a teacher would ideally tailor their approach to code-switching based on the linguistic competence of the students. In non-advanced classes, it may be more important to accept code-switching, whilst encouraging L2 use. In addition, teachers should consider cultural factors and pacing of the course. In a Japanese context, divergent thinking tasks may take longer than expected, and convergent thinking tasks may be easier to facilitate. Even for more advanced classes, developing competency to conduct DT activities fully in English will require practice and time. Conducting the course over a 15-week period would enable students to complete the DT process more than once. This could allow students to develop on-task competencies and a greater understanding of the creative process.

Secondly, in order to maximize the number of students who engage with the concept of creativity it may be beneficial to breakdown report writing into more focused paragraph writing over the duration of the course. Although some students provided a definition of creativity and used the DT lexis in their work, not all students could. When students explained creativity in their reports, they talked about specific examples of famous people or people they personally knew as being creative. Instead of writing a long report, it could be beneficial to focus on one paragraph a week, starting with concrete examples of creative people and products. After getting students to reflect on the creativity around them, the teacher could then ask the students to take on more conceptually challenging work such as writing about creativity as a process and, then finally writing an abstract definition. This could allow more students to reach a deeper conceptual understanding of the creative process and the iterative processes of divergent and convergent thinking that are the cornerstone of DT.

Thirdly, if the course is to be delivered within an eight-week timeframe, we should consider providing greater access to materials outside of the classroom. For example, simplifying and shortening the written texts; allowing students to access DT information in different modes (short demonstration videos with subtitles that can be accessed online). This would give students greater autonomy over their learning and more time to understand the methods of DT-based problem solving. These measures may encourage students to create collaborative teams using the wide array of more traditional EFL community-building activities (see examples in Harmer, 2007 and Scrivener, 2005).

Conclusion

The results of this research suggest DT could be a form of creative press that facilitates the development of twenty-first century skills in the EFL classroom. The centrality of dialogue and collaborative problem-solving generates a constructivist and motivating learning environment. Firstly, students enjoyed the activities and gained confidence about their communication and thinking skills. DT gave students greater autonomy and allowed learning outcomes to emerge from the problem-solving process. Through iterations of divergent and convergent thinking students could practice and develop confidence in thinking about problems and discussing them in a team. The requirement to make solutions fit for purpose makes DT suitable for groups whose interpretation of creativity foregrounds appropriateness. Secondly, DT enabled creative uses of English. The tests that students made utilized English communication and grammar in creative ways and gave students experience of creating an English product, watching others use it and getting genuine feedback. However, due to the complexity of the design challenge, students sometimes reverted to Japanese during discussions. Accordingly, during on-task activities teachers should ideally tailor their approach to code-switching based on the linguistic competence of the students. In addition, the use of concrete examples and multimodal learning experiences may help some students engage with the concept of creativity and benefit more from such a course. If these considerations are taken into account, DT may be an effective and culturally suitable approach to facilitating the use of twenty-first century skills in an EFL setting.

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