# That's a Good Question: Using Design Thinking to Support the Development of Divergent Thinking Practices in First Year Students


## Abstract

Design thinking is a critical and creative process understood to support innovation and creative idea generation in a wide variety of contexts. Increasingly, it is being used as a pedagogical approach by educators interested in supporting divergent thinking skill development. This study evaluated the effect of the use of design thinking practices on student learning within the context of the first-year post-secondary classroom. Analysis of student generated reflective statements and of in class student work demonstrated that the use of design thinking practices may improve creative and critical thought and may enable students to achieve question focused and divergent thinking focused learning outcomes more easily. We know that the core of all student learning is in asking strong and resonant questions – this study demonstrates that the inclusion of design thinking practices in an undergraduate learning community may foster the skills required to do this critical work.


## Introduction



Students are trying to learn how to ask strong and divergent questions every day in each of their classroom engagements, but we know as researchers interested in the scholarship of teaching and learning that this is an elusive and difficult skill set to develop in the course of in-class learning (Iverson, 2018). Instead, undergraduate students across disciplines often rely solely on convergent and solution-oriented question types, a heuristic that may limit their creative and critical thinking skill development (Goldschmidt, 2016). Instead of "how might we…?" they ask "how does it work?". Instead of "what would happen….?" they ask "what have I seen happen before"? This experience prompts us to seek a new model for an interdisciplinary and research focused classroom, one which uses unconventional research practices to introduce divergent thinking strategies to the undergraduate learning community. We find such a question asking culture in a knowledge production space look into a setting where a community of practitioners have developed the ability to generate new, creative and critical thoughts in a reliable, repeatable manner within tight time and resource constraints: the design studio. Designers ask questions (Allhutter, 2012) they seek and develop divergent though practices (Brown, 2008; 2009) and their very livelihood depends on the generation of new ideas – new ways of seeing the world. In short, the design studio serves as a model classroom environment that could be used by those seeking to foster divergent and strong question asking skills as a learning outcome for their students. In this study, we explored what we

might learn from adopting the play focused research and learning strategies of the design studios in our classroom context. Can design thinking help students learn how to ask stronger questions by adding an element of creative play?

This study of student learning and the impact of design thinking practices on divergent thinking focused learning outcomes is rooted in the particular local context (Hutchings & Huber, 2005) of the interdisciplinary, first year undergraduate seminar classroom, and not of the design studio. As such, it provides a new perspective into the use of a well-established creative process in an untraditional context. Many investigations of the use of design thinking practices examine the use of the five-stage process in corporate brand, product, and strategy development work (IDEO, 2019). Here, we explore what happens when we use design thinking to help in the first stages of creating new thoughts and questions in partnership with student learners.

As Mitchel Resnick explains, "Learning happens when we actively construct new ideas. We don't get ideas, we make ideas" (Freakonomics, 2018). In this contribution to the larger scholarly conversation on idea generation and thinking processes, we experiment with one approach to nurturing our student's abilities to make new, generative, critical and creative ideas. Our question is, at its root, a description of "what works" (Hutchings, 2000, p. 4): this paper presents evidence on the effectiveness of design thinking practice as a teaching approach, and outlines our attempt to redesign what it may look like to teach research skills in a new way. This micro level study of the activities of faculty members and students in collaboration (Williams et al, 2013), is an attempt to understand whether the use of a particular creative process originated in the design studio may contribute to student learning. Specifically, we ask: do playful design thinking practices help students learn to ask better questions?



**Overview**

As Santana, Minigan and Rothstein (2015) have has identified, learning to ask the right question is critical for student learning in the undergraduate setting – so critical that it has been listed as the foundation of six of the ten "future skills" in the World Economic Forum's *Future Jobs Report* (2018) and as key component of the majority of high impact practices proposed by Kuh (2008). However, Minnigan and Beer's work on the Question Formulation Technique in higher education indicates that developing strong and divergent question forms remains an area of growth in the undergraduate learning community (2017). Why do students find it so hard to hone their question asking skill set? Haasi and Laasko (2011) suggests that within a learning community where questions are often discouraged, individuals at any level of expertise may rely heavily on solution finding, rather than

question asking, activities. The role of evaluation and feedback has also been discussed by the educational development team at IDEO, who outline the impact that a reliance on summative evaluation practices can have on the development of question asking skills (IDEOU, 2019).

Questions form the heart of the research process in any academic environment, but they are also the distinguishing feature of a key learning strategy in the field of creativity and critical problem solving: design thinking. Design thinking, or the use of specifically ordered practices of creative problem solving in an innovation focused environment, is a learning process employed by creative and cultural producers tasked with, as Simons explains, "changing an existing state to a preferred one" (1968). This process of creative problem solving has been well explored in the field of design and creativity studies (Cross, 2006; 2011) and has recently become an important part of the national conversation about global and social innovation education (Brown, 2010). In the Canadian university context, invoking "design thinking" in discursive practice has become synonymous with conjuring up the "designerly" way of thinking and knowing (Cross, 1982; 2006) that stands in for all that is good about creative and innovative work (UCalgary, 2019). Indeed, design thinking (in its many forms) is often describe as the "unicorn skill" (Maeda, 2019) of a generation of students invested in using their undergraduate education to re-imagine how social, health care, policy, educational and industry-focused decisions are made. At the core of what is meant by design thinking is an iterative process of problem identification, empathy, iteration, prototyping and testing (Brown, 2008) – one supported by a vast array of social practices and learning strategies developed through creative collaboration between designers and users (IDEO, 2019).



The key point of alignment between the power of design thinking methods and the development of critical and creative thought processes in undergraduate student learners is the first step of the design thinking process: identifying problems by asking questions (or as Brown defines it in his undergraduate class on life design at Stanford University, getting curious). As Helfand has illustrated in her work on design communities, this ability to generate divergent and convergent thought while diving ever deeper into the question asking process is the critical skill of the designer (2016). In fact, members of design communities have reported that learning to ask questions – about how a thing might be done, or what possibilities arise from a unique situation – is both the most critical and the most challenging part of their creative and cultural production work (Dorland, 2018). The ability to develop strong questions, and to remain "curious" (Brown, 2008) for extended periods of time enables designers to generate more creative, innovative and authentic solutions to critical social and cultural challenges (Dorland, 2018). Research conducted in undergraduate studio

courses suggests that design thinking practices such as those employed in this study may be key to establishing the development of creative and critical thought in student communities as well (Rashdan, 2017).

MIT researcher and computer scientist Mitchel Resnick proposes in his work on divergent thinking processes (2017) that aspects of creative and critical thought – or the making, rather than the getting, of ideas – are premised on four key elements, each of which can be enhanced in the learning experience. Projects (or the iterative development of an idea towards a goal) provide students with a required point of focus; passion (or the alignment of learning activities with learner interest) fuels the collaborative work of a classroom; and peers provide and support reflection and reflection-in practice (Schön, 1983). What is most often left unconsidered though in the higher education classroom space is play: the deliberate implementation of opportunities to explore ideas and directions of thought. Resnick identifies two models that can support the critical and creative thinking fostered by play: the 'playpen' and the 'playground'. Playpens, according to Resnick, provide opportunity for limited and bounded creativity, and can be supportive and generative while employing clear boundaries for playful thought. The playground, on the other hand, is an analogy for an experimental space where students are able to develop and nurture their creative and critical thinking practices (Resnick, 2017).



In his work on social innovation pedagogy, Tim Brown has argued convincingly that design thinking practices, whether deployed in the studio space, the boardroom or the classroom, are supportive of exactly this type of play-informed creative and experimental learning process (2008). Additionally, he suggests that design thinking (or what Resnick refers to as playground learning) practices may contribute towards a better understanding of psychologist Joy Paul Guilford's foundational work on convergent thinking and divergent thinking (1967). As Guillford outlined, creative thought is reliant on both convergent and divergent thinking practices – without the balance between the two students would be unable to integrate critical and reflective work into their idea generation. However, Briggs (2014) summarizes the many ways that the convergent thinking practices of undergraduate students are already well supported and suggests it is incumbent on educators to foster skills in divergent processes of thought instead. Of great interest to the research collaborators and students involved in this study are the studies of how design thinking-based learning strategies have contributed to increased efficacy in the development of divergent forms cognition, production, and evaluation (Guilford, 1967).

## The study

*Purpose*

Our motivation for undertaking this study of student learning was twofold. First, we are design practitioners and researchers interested in the application of creative problem-solving strategies commonly used within our studio settings to the higher education classroom in which we serve as faculty instructors. And secondly, in our review of the literature outlining evidence about the impact of design thinking practices in generating innovative or critical thought, we found little on the impact of these practices in understandings of student learning. In our estimation, design thinking practices, or what Resnick might call "playground" style play, represent a powerful arsenal of new approaches to the development of divergent thinking processes and, as such, we sought in this study to examine how what we use so often in the studio might be deployed in support of key student learning outcomes. This study assesses student experiences of design thinking focused learning strategies, and their reflections on how the design thinking practices that we recognize from the creative studio might bolster or strengthen the questioning skills we know are so critical to the undergraduate learning experience. In collaboration with student partners, we investigated the following research questions:



- Does the use of learning strategies that include design thinking practices improve the strength of student generated questions?
- Does the use of learning strategies that include design thinking practices increase divergent thinking activities?
- After engaging with design thinking practice, do students ask questions in a different way?
- How effective did students think design thinking methods were as a method of improving their question asking abilities?

This study contributes to a gap in the literature on both student learning and creativity, especially with respect to new options for using design thinking as a tool for research practice and critical thinking at the undergraduate level. Though this study examined the use of design thinking in a group learning and undergraduate context, the evidence generated and analyzed in partnership with student learners presents potential new areas of exploration that can be taken up by SoTL researchers interested in individual research practice skill development and the development of creative and critical thought in experiential learning environments.

*Method*

Taking an exploratory approach (Spaulding, 2014) to studying student learning, as is common in much SoTL research, meant using methods such as content analysis, participant and non-participant observation, and the study of documents and artifacts to generate an interpretive and constructivist understanding of the beliefs and practices of a community (Keating, Atkinson, Coffey, Delamont, Lofland, & Lofland., 2001). As Gains has outlined in her examination of fieldwork a participant-inclusive or collaborative approach to research and fieldwork can be understood on a continuum from method (or technique for "accessing and analyzing observations") to "interpretivist methodology with attendant ontological and epistemological underpinnings" (Gains, 2011, p. 161). This study incorporates aspects of both ends of the continuum, as indicated by the protocol outlined below, while retaining a focus on local priorities of our class and the learning community that we had developed (Wholey, 2010).

Our collaborative approach to understanding the impact of design thinking practices on student learning assumed that learning culture began not with the course syllabus, but "on ground level, with footsteps" (de Certeau, 1984). In asking how students do what they do when they do what they do in this study, we sought not only to walk in their footsteps but in their shoes – an approach that required us to integrate student collaborators into all aspects of the research process (Felten, 2013; Hutchings 2000). For this aim, integrating collaborative methods of data generation, student led reflections and student generated analysis of artifacts was an ideal fit. Focusing on a collaborative approach that incorporated student learners as research partners allowed us all to focus on considerations of learning as a lived practice engaged within a community that included both instructor and student members (Lave & Wenger, 1991). Our methodological approach in both data collection and analysis was aimed at generating "thick" descriptions based on "being there" (Borneman & Hammoudi, 2009), a goal that would have been impossible to realize without the collaborative input of student participants.



*Participants*

For the purposes of this study, we collected data in partnership with students from two sections of a first year, interdisciplinary and inquiry-based open studies course at a large research focused Canadian University. We worked with students in relatively small class sizes (with less than 30 enrolled students per section) and 95% of students in each section consented to participate and to include their work as part of our data set (n=37). Students who did not chose to consent to participate in the project (n=2) were able to expunge their class work from the final data set (including their reflective statements and question samples), and to debrief their experience

individually with the course instructor. Over the course of the study we documented 12 observation opportunities for each section of the course (with a total of 24 observation opportunities). The data generated by both course sections was combined for the purposes of analysis, and the amalgamated data set is presented and discussed below.

Students who participated in this study met twice a week for a 90-minute course focused on developing a personal research practice. The course context that forms the basis for this study was classified as an open option for university undergraduate students, which meant that any student with less than one year of course credit at the institution was able to enroll (regardless of major, GPA or faculty designation). Student participants came from eight disciplines of study and were enrolled in the faculties of arts, engineering, science, education, social work and kinesiology. All participants in this study self-identified as first year undergraduate students aged 17 – 23, and the course that provided the context for this study was taken during their first term of study at the University. This is especially important because this meant that student participants were engaging with some of these learning outcomes and learning practices for the first time and were participating in research on their own learning for the first time as well. The instructor for this course taught both sections included in this study and brought a background in qualitative research and design practice to their work as a facilitator and guide for student learning.



*Procedure and Data collection*

Student participants in this study were recruited by a research assistant with no connection to class work or course evaluation during the first day of class. They were given the opportunity to review the study protocol, CFREB ethics approval statement and the study's alignment with the learning outcomes of the class and to discuss the details of participation with the research assistant. Informed consent for participation was granted by students after this initial briefing session with the research assistant and re-confirmed at the end of the study prior to the final debriefing session.

In an attempt to answer the question of whether design thinking practices can help students learn how to ask stronger and more divergent questions, we began our study by collaborating with students on a baseline definition of a 'strong question'. During the first week of class, students participated in a facilitated exercise where they identified the characteristics of 'strong' and 'weak' questions (as outlined in Figure 1 below). This guiding taxonomy of strong and weak question types was then made available to students for their use on our course management platform (and was referred to during course work throughout the rest of the term). After this facilitated exercise,

students were prompted in their course management platform to write a brief (>200 word) reflective statement on how asking strong and divergent questions may be of benefit in their learning practice.

Students then spent the next four class sessions (two weeks of course time) engaging in facilitated group discussions aimed at generating question statements that they could use in their research on the common course project. We defined this portion of the study as the 'playpen' phase. These facilitated discussions employed the following strategies of question generation:

1. Group discussion.
2. Brainstorming/mind mapping.
3. Research using secondary sources of peer reviewed scholarship
4. Discussion based case study analysis.

In each of the class sessions (lasting 90 minutes), students were grouped in small teams of five team members of less and were tasked with generating questions that they felt would guide their research process moving forward. Questions were tracked by writing them on sticky tabs coded numerically for future categorization and all generated questions were collected at the end of the session, transcribed to a shared document posted on the course management platform, and kept for analysis. At the end of these four sessions, students were prompted in their course management platform to write a brief (>200 word) reflective statement on their experience of generating guiding questions for researching the common class project using the strategies deployed in this phase of the course work.



Students then spent the next four classes (two weeks of class time) working with design thinking methods to generate question statements. This phase of the work required additional work on behalf of the course instructor and the students as many of the design thinking methods engaged in this phase required adapting to new skills and approaches as part of the research process. We defined this portion of the study as the 'playground' phase. Questions were tracked in the same manner as phase one (with sticky tabs coded using numeric indicators) and transcribed for course use in a common document. This second set of four facilitated sessions employed the following strategies to help students generate guiding questions for the common class project:

1. Ethnographic future studies (using student generated samples of media representations of futures to conduct hypothetical ethnographies of future states).
2. Shadowing and participant observation (whereby students embedded within a social setting of their choice to develop an understanding of a different context).

3. User experience journey mapping (where students map the experience of a subject involved in a possible solution to the class project and generate questions that the subject might pose at any given intersection on their journey).

3. Interviews (using student generated lists of participants that may offer a perspective into the impact of a possible solution to the class project).

At the end of these four sessions, students were again prompted in their course management platform to write a brief (>200 word) reflective statement on their experience of generating guiding questions for researching the common class project using the strategies deployed in this phase of the work.

Phase three of the study asked student participants to engage in a sorting exercise of all questions generated in phase one (playpen) and phase two (playground) classes, using a matrixed version of the original taxonomy of strong and weak question types generated at the beginning of the study. Students worked with their peers to place the question sticky tabs on the large wall sized matrix in a way that would indicate their placement on the continuum of strong to weak question forms using the particulars of each type identified in the taxonomy. Students were not able to see whether the questions had been generated during the first or second phase of the project during this sorting exercise, and the questions used were not sorted into teams or groups (and were rather compiled as one common pool or selection).



Finally, students met again with a research assistant who conducted a debriefing exercise with a particular focus on the learning outcomes identified at the beginning of the study, and the student's self-evaluation of their question formulation skill development. At this informal gathering, students were also invited to share their experience with the different learning practices employed during both phase one and phase two of the study. The world café method used at the end of the three phases of this study is well suited to uncovering patterns of connection amongst experiences of both design thinking based learning and more conventional learning approaches (Brown, 2005), which allowed us to extrapolate and broaden our understanding of the individual experiences shared by students in their reflective statement feedback.

*Data analysis*

After the collaborative data collection work was finalized, we used qualitative content analysis to derive coding categories directly from the collected and transcribed data (Hsieh & Shannon, 2005) using a descriptive approach to examine the larger narrative presented by the student generated question matrix and reflective statement texts (Braun & Clarke, 2006). We began

by reading the data broadly as a whole to develop a contextual understanding of the student perspective presented in the reflective statements. Then we employed thematic content analysis to examine the reflective statements for commonalities (or themes), and to use these themes to better understand the question matrix data generated by students about the questions they had created during phase one and two of the study.

These themes were then shared on the course management platform with student participants in order to include their reflection and feedback in the development of final coding categories. One theme was adjusted for clarity based on the feedback shared by students. All other thematic categories were found to be well aligned with the responding student's experience of their learning in class. Data collected through the reflective statements and the student-generated question strength continuum was then analyzed using Quirkos by two researchers, and the themes used (inclusive of the student suggested change) demonstrated a high level of inter-rater reliability.

## Findings

*Student Definitions of Strong and Weak Question Types*

Students began their work in understanding the role of design thinking practices in the question formulation process by generating a taxonomy of strong and weak question types (Figure 1). All enrolled students (n=39) took part in the generation of this taxonomy during their class time.



*Asking Questions After Time Spent in the Playpen, and in the Playground.*

Analysis of the reflective statements generated after in class work during both the playpen (first) and playground (second) phases of the study (n= 74) generated the following themes:

1. Producing unexpected or new directions for further research
2. Generating possible solutions to the larger class project
3. Contextualizing or exploring the larger class project
4. Decoding or evaluating thinking processes
5. Testing possible solutions to the larger class project
6. Uncovering assumptions or gaps in knowledge
7. Building on pre-existing knowledge basis
8. Drawing from the lived experiences of others
9. Identifying unknown particulars of the larger class project

*Phase One: The Playpen*

The number of reflective statements generated using "playpen" learning strategies (group discussion, brainstorming or mind mapping, secondary peer reviewed research, and case studies) that included content related to each theme is outlined below in Figure 2. Student generated reflective statements often corresponded to more than one thematic code, though that was not always the case. In this phase of the study, most students reflected on the facets of the larger class project that were unfamiliar or unknown. 18 student participants discussed the complexities of identifying unknown particulars of the larger project as they key contribution of their question asking process. One student participant commented that:

> "Doing questions through the group work helped me understand more about the bigger challenge and now I know what I need to research more about. I didn't understand the bits involved and now it is coming together."

Other students (68%) focused their reflections on the way that asking questions through group discussion and brainstorming (or mind mapping) helped them build on their pre-existing knowledge basis. In particular, students reflected on the commonalities of their experience and knowledge and the complexities of the class project:



> "I asked questions about how this is the same as some of the things we do because the things we do aren't all that different than what's happening in the rest of the world. Everyone is the same and if we just ask questions about things we can understand then we can find what we have in common and use that to create a good solution."

The most common theme in student reflections generated after the four classes in which they developed questions through group discussion, brainstorming or mind mapping, the use of secondary peer reviewed research and case studies was the overwhelming nature of questions themselves and the tendency of questions to prompt unexpected or new directions for further research. As one of the 23 participants who reflected on this theme noted:

> "You ask a good question but you can't just use that. A question just makes everyone else in the group go off in a new direction and you can't bring it back to what you are supposed to be thinking about. Having a group for this part was hard and having to jump in with more questions everyday just confused us"

*Phase 2: The Playground*

The number of reflective statements using the playground learning strategies (ethnographic future studies, shadowing and participant observation, user experience journey mapping and interviews) that included content related to each theme is outlined below in Figure 3. Again, student generated reflective statements often corresponded to more than one thematic code, though that was not always the case.

In this second phase of the study, far more reflective statements focused on the importance of drawing on the lived experience of others as key in their question generating process (77%). In these statements, students reflected on the role of moving outside of the own knowledge base and their own context to learn more about the complexities of the larger class project from the point of view of others, and 21 students mentioned "getting outside your own bubble" or "leaving your comfort zone" as part of developing a strong question.

> "I wasn't thinking of what questions to ask about how a solution might work before doing this part of the class. I was just thinking about what might work, but I can see more about impact now than I did then."



> "There are lots of sides to the problem but we already knew more about that. I didn't really think of how many people or what kind of people were involved now and I'm asking more interesting questions now that I do."

Additionally, students reflected on the role of their questions in testing possible solutions, and in evaluating their own thinking process. Fully half of all submitted statements included reflections on the role of using the questions generated at the beginning of the process to better understand the validity of the solution that they would propose at the end. One participant noted that:

> "Without the good questions that came from the interview I wouldn't have a way to know if my proposal would work or not. Now I have something to navigate with."

*Phase Three: Sorting exercise*

Some of the most interesting outcomes from our study came from the sorting exercise that students completed after phases one and two of the research. After reviewing their class-generated definition of strong versus weak questions, and after a group discussion about the merits of convergent and divergent thinking practices (as defined by Guilford), students worked

collaboratively to plot all of the questions generated during their in-class work onto a large 2 x 2 matrix, as we share below. Questions generated during phase one of the study (using learning strategies such as group discussion, case studies, secondary peer reviewed research and brainstorming or mind mapping) are indicated in Figure 4 below using a red dot. Questions generated using phase two of the study (using design thinking focused learning strategies such as ethnographic future studies, shadowing and participant observation, user experience journey mapping and interviews) are indicated in Figure 4 using a blue dot. Students did not know which questions were generated during phase one and phase two of the study, and placed questions onto the matrix based on their current interpretations of the question itself.

This matrix indicates that students were more likely to categorize questions generated during the 'playpen' phase of the study as weak and convergent in nature (58% of total questions generated during phase one) and, conversely, more likely to categorize questions generated during the 'playground' phase of the study as strong and divergent in nature (52% of total questions generated in phase two). Students debated the placement of each question in the matrix, with many landing in (as one participant described) the "in between zones" of divergent/weak questions (23%) and convergent/strong questions (18%). Fully 85% of the questions generated in the 'playground' (with the learning strategies generated using design thinking) were categorized as strong, with either a divergent or a convergent focus.



As part of the debriefing protocol for this last phase of the study, students worked as a group to generate a representative question from each quadrant of the two by two matrix, as indicated in Figure 5 below. One participant shared in the final reflective statement that she completely revised her approach to both generating and using questions in her research work as a result of this sorting exercise:

> "I never thought about how I could make the question do the work when it came to setting my direction. I always used the questions that were clearest, but I think the ones I liked best and that I identified with were more the ones that led you in a million directions and made you think a little harder."

## Discussion

In this study, we examined whether students could learn to ask stronger and more divergent questions by using design thinking oriented learning strategies to support what Resnick defines as a playground, rather than a playpen, classroom environment. We analyzed the differences and

commonalities between reflective statements generated by student participants after engagement with what we defined as 'playpen' learning strategies (including group discussion, case studies, secondary peer reviewed research and brainstorming or mind mapping) and 'playground' or design thinking oriented learning strategies (including ethnographic future studies, shadowing and participant observation, user experience journey mapping and interviews). We asked how students defined strong versus weak question forms, how they experienced generating questions using different types of learning strategies, and how they understood their own work in relationship to divergent and convergent thinking paradigms after having reflected upon different learning practices. Our intent was to better understand whether a 'playground', or design thinking oriented environment truly supported the development of creative and critical thinking skills in first year undergraduate learners.

Our key findings about the impact of design thinking on this particular aspect of student learning can be grouped into two larger categories which align with the literature in the field of innovation and creativity (most notably the work of Guilford, 1968): convergent processes, and divergent processes. First, the evidence suggests that the use of design thinking as a learning strategy supports and nurtures the development of divergent thinking approaches, in respect to the activities of cognition, production and evaluation. Secondly, the evidence suggests that the use of playpen (or limited creativity) learning strategies can still support the development of strong question forms, but also formulates more convergent thinking practices among undergraduate students – increasing the solution determinacy of student efforts and decreasing the function of play as a form of exploration in the making of new ideas.



The majority of participating students reflected at least once (68%) upon the positive difference in their individual learning approaches after engaging with design thinking practices, which exemplifies the positive role such learning activities may play in the classroom. This suggests that after engaging with design thinking practices in their learning strategies, students might be asking questions in a different way – one that is perhaps more aligned with the high impact practices identified in the literature on student learning and creative practice (Kuh, 2008). One third of student reflections about their improved learning approaches also made reference to aspects of what Dweck (2008) has defined as a growth mindset: specifically, that they were developing knowledge over time, and that they were learning more from failed question forms than from successful ones. We interpret this to mean that design thinking practices, when engaged as learning strategies, may have a positive effect on the development of a growth mindset in students.

What becomes evident in our examination of the matrix of question types and of the sample representative questions generated by students is that students find divergent and strong questions to be especially generative for creative and critical thought – and that the use of design thinking learning strategies enabled the creation of those question forms. As Resnick identified, the critical and creative thinking generated through playground form play (in contrast to the limited opportunities for creativity found in playpen style play) supported more resonant and deeper expressions of student learning. Our local context was well grounded in the creative learning foundations identified by Resnick: project, passion and peer supports were strong and aligned with our group and inquiry-based learning approaches to the work as a learning community. With that in mind, we understand the integration of design thinking practices to be the critical variable in the development of strong and divergent question forms: using design thinking in the class appears to increase the playground, and decrease the playpen, nature of play in creative learning.

How effective did students think design thinking methods were as a method of improving their question asking abilities? In final reflective statement data nearly two thirds of the students reported that their strongest and most divergent questions came from the design thinking process, and many indicated the applicability of this process to other course work. Our interpretation of this finding is that the learning strategies introduced through design thinking practices are transferable, useable and well aligned with all forms of student inquiry, and not just creative practice. 78% of students reflected on the playful nature of the design thinking practices they encountered during the second phase of the study, and on the freedom that these processes engendered. Additionally, 59% shared that their experience of the design thinking (or playground) practices used as learning strategies allowed them to take on additional points of view or diverse perspectives in order to generate new ideas or approaches to a problem. These two findings indicate to us that incorporating design thinking practices as learning strategies in the undergraduate classroom is both a positive student experience, and a potential high impact practice in the development of citizenship and global perspective development.



Perhaps the most interesting aspect of the data that emerged after thematic analysis was the differentiation students made between the uses of questions in their future work. Design theorist Lucy Suchman (2011) refers to the use of "navigating" and "wayfinding" as a helpful analogy to understand the differences that students reflected upon, and we feel that it supports the data presented here as well. In this study, students shared that a "navigating" approach to creating new ideas through question development required them to presuppose a solution, and to plan a series of

inquiries that will help them arrive at the designated result. On the other hand, students using a "wayfinding" approach to developing new thoughts or making new ideas instead relied on an interative process of trial and error – on exploring the territory of the ideas in development rather than developing ideas in service of a solution. In this study, we saw students applying a wayfinding approach to developing questions during the "playground" phase of their work – an approach that, if nurtured, may be of benefit to students exploring the development of new ideas in more traditional learning environments.

**Limitations**

Our study of whether the use of design thinking methods can help students ask better questions was limited in several ways, which we summarize here. Our hope is that with consideration of these limitations in mind we may be able to find new ways to further examine this function of student learning in higher education.

First, student participants in this study came into their role as learners and collaborators on data generation with a preconceived awareness of the value of design thinking, and the value of divergent thinking practices. Phrases like "thinking outside the box" and "thinking differently" formed a second level theme during the coding of the first round of reflective statements, indicating that students were prepared to value divergent practices more highly than convergent thinking methods. Additionally, the student's enthusiasm for the learning strategies involved in phase two was markedly higher, which may have resulted in students placing a higher value on the questions formed using these tools. This is difficult to mitigate, as the active and experiential strategies associated with design thinking are, in this author's opinion, just more fun. With that in mind, it may be worthwhile to examine different pairings of learning strategies in future in order to work around this limitation in the data collected.



Secondly, due to the structure of the study, students may have been improving the strength of their questions in ways that could not be explained by the use of the design thinking practices. For example, students had already been familiarizing themselves with the larger class project for several weeks before tackling the second phase of learning strategies. Additionally, students had developed a familiarity with the class dynamic, with their section peers and with their role in the larger University community before beginning phase two of the study. The steep learning curve present in all first-year student experiences may have been a factor in the type of work generated by students for analysis. Researchers interested in considering the role of design thinking within the development of critical thinking and reflective practice in first year programs may consider

reordering the introduction of learning strategies or running two different classes in parallel in order to assuage this effect.

Finally, many student participants indicated in their reflective statements and during the debriefing sessions that were not comfortable with group work and group discussion. This is a critical issue for many undergraduate students and a notable one for first year students in general. This discomfort with group work may have caused some contributions to go unheard during class time, or even have caused some students to silence themselves during the creation of questions in phase one and phase two of the study. It is important to note that though students reflected on their discomfort with group work, none of the participants indicated that this discomfort extended to non-participation in the class learning.

## Conclusion

Our research demonstrates that design thinking practices, when integrated into a playful, peer directed, project oriented and passion fueled learning engagement, may improve creative and critical thought and may enable students to achieve question focused and divergent thinking focused learning outcomes more easily. We know that the core of all student learning is in asking strong and resonant questions – this study demonstrates that the inclusion of design thinking practices in an undergraduate learning community may foster the skills required to do this critical work.



Our hope is that this research helps outline why and how design thinking can be an effective learning strategy, and how it can be re-imagined as a formative research methodology to be used in any learning engagement. The data generated in collaboration with students as part of this study indicates that the skills developed through the use of design thinking practices can be transferred to other learning engagements, and that students find this form of learning engaging and well aligned with a growth mentality. This study demonstrates the ways in which design thinking practices can support divergent thinking, creative practice, critical thought and student learning – and how design thinking is not just for designers any more.

**References**


Allhutter, D. (2012). Mindscripting: A method for deconstructive design. *Science, Technology and Human Values, 37*(6), 684-707.

Borneman, J., & Hammoudi, A. (Eds). (2009). *Being there. The fieldwork encounter and the making of truth.* Berkeley, CA: University of California Press.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101.

Briggs, S. (2014). 30 Ways to Inspire Divergent Thinking. [Blog posting] https://www.opencolleges.edu.au/informed/features/divergent-thinking/ Retrieved June 2019.

Brown, T. (2008). *Design thinking.* Harvard Business Review, June, 84-92.

Brown, T. (2009). *Change by design: How design thinking transforms organizations and inspires innovation.* New York, NY: Harper Business.





Brown, T., & Wyatt, J. (2010). Design thinking for social innovation. *Stanford Social Innovation Review.* Winter 2010. 31 – 35

Cross, N. (2006). *Designerly ways of knowing.* London, UK: Springer.

Cross, N. (2011). *Design thinking: Understanding how designers think and work.* Oxford, UK: Berg.

de Certeau, M. (1984). *The practice of everyday life.* Oakland, CA: University of California Press.

Dorland, AM. (2018). *Doing design thinking: An ethnography of the digital graphic design studio.* Doctoral dissertation, University of Calgary.

Dubner, S. (2018). Where does creativity come from: and why do schools kill it off? [Podcast] http://freakonomics.com/podcast/creativity-2/. Retrieved July, 2019.

Dweck, C. (2008). *Mindset: The new psychology of success.* New York, NY: Random House.

Felten, P., Bagg, J., Bumbry, M., Hill, J., Hornsby, K., Pratt, M., & Weller, S. (2013). A call for expanding inclusive student engagement in SoTL. *Teaching & Learning Inquiry: The ISSOTL Journal*, *1*(2). 63 – 74

Gains, F. (2011). Elite ethnographies. *Public Administration, 89*(1), 156-166.

Goldschmidt, G. (2016). Linkographic evidence for concurrent divergent and convergent thinking in creative design. *Creativity Research Journal, 28*(2), 115-22.

Guilford, J. P. (1967). *The nature of human intelligence.* New York, NY: McGraw-Hill.

Hassi, L., & Laasko, M. (2011). *Conceptions of design thinking in the design and management discourse.* In Proceedings of the 4th World Conference on Design Research. Delft, Netherlands.

Helfand, J. (2016). *Design: The invention of desire.* New Haven, CT: Yale University Press.



Hsieh, H., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research, 15*(9), 1277-1288.

Hutchings, H., & Hutchings, P. (2005). *The advancement of learning: Building the teaching commons*. San Francisco, CA: Jossey-Bass.

Hutchings, P. (2000). Approaching the scholarship of teaching and learning. *Opening Lines: Approaches to the Scholarship of Teaching and Learning.* Princeton, NJ: Carnegie Foundation for the Advancement of Teaching. 1 – 11.

IDEOU. (2019). *IDEOU. Solve anything creatively.* [Web page]. Retrieved from https://www.ideou.com/

Iverson, B. (2018). *The importance of learning to ask the right questions.* https://news.utexas.edu/2018/03/05/the-importance-of-learning-to-ask-the-right-questions/. Retrieved July, 2019.

Keating, E., Atkinson, P., Coffey, A., Delamont, S., Lofland, J., & Lofland, L. (2001). The ethnography of communication. In P. Atkinson (Ed.) *Handbook of ethnography* (pp. 285 - 302). London, UK: Sage.

Kuh, G. (2008). *High-impact educational practices: What they are, who has access to them, and why they matter.* Washington, DC: Association of American Colleges and Universities.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* Cambridge, UK.: Cambridge University Press.

Maeda, J. (2019). *Design in tech report.* [Annual Report] https://maedastudio.com/ Retrieved June, 2019.

Minigan, A., & Beer, J. (2017). Inquiring minds: Using the question formulation technique to activate student curiosity. *The New England Journal of History*, *74*(1). 114 – 136.



Rashdan, W. (2017). Impact of design thinking on conceptual design in interior design studio courses. *PEOPLE: International Journal of Social Sciences*, *3*. 85-99.

Resnick, M. (2017). *Lifelong kindergarten. Cultivating creativity through projects, passion, peers, and play*. New York, NY: MIT Press.

Rothstein, D., Santana, L., & Minigan, A. (2015). Making questions flow, *Educational Leadership, 73*(1). 70–75.

Schön, D. (1983). *The reflective practitioner: How professionals think in action*. New York, NY: Basic Books.

Simon, H. (1968). *The sciences of the artificial.* Boston, MA: MIT Press.

Spaulding, D. T. (2014). *Program evaluation in practice: Core concepts and examples for discussion and analysis* (2nd ed.). San Francisco, CA: Jossey Bass.

Suchman, L. (2011). Anthropological relocations and the limits of design. *Annual Review of Anthropology, 40*(1), 1-18.

UCalgary (2019). *Design thinking: What is it and why should I be doing it.* [News article] https://ucalgary.ca/news/design-thinking-what-it-and-should-i-be-doing-it. Retrieved May 1, 2019.

Wholey, J. S. (2010). Exploratory evaluation. In J. S. Wholey, H. P. Hatry, & K. E. Newcomer (Eds.), *Handbook of practical program evaluation* (3rd ed., pp. 81–99). San Francisco, CA: Jossey Bass.

Williams, A., Verwoord, R., Beery, T., Dalton, H., McKinnon, J., Strickland, K., Pace., J., & Poole, G. (2013). The power of social networks: A model for weaving the scholarship of teaching and learning into institutional culture. *Teaching & Learning Inquiry: The ISSOTL Journal*, 1(2). 49-62.



World Economic Forum. (2018). *The future of jobs report.* Geneva, Switzerland: Centre for World Economy and Society, World Economic Forum.

*Fig. 1, Student Generated Taxonomy of Strong and Weak Question Types*

| Weak questions | Strong questions |
|---|---|
| Easily solved.<br>Are answered based on my prior knowledge.<br>Have answers that don't generate more questions.<br>Don't make me think.<br>Aren't very interesting to others.<br>Lump things together. | Are difficult to solve.<br>Require new experiences for me to answer them.<br>Breed new questions for me to think about.<br>Make me think about new things.<br>Are interesting to others.<br>Blow things apart. |

*Fig. 2, Thematic Analysis of Phase One Reflective Statement Responses*

| Theme | N | % |
|---|---|---|
| Producing unexpected or new directions for further research | 5 | 14% |
| Generating possible solutions to the larger class project | 29 | 78% |
| Contextualizing or exploring the larger class project | 17 | 44% |
| Decoding or evaluating thinking processes | 2 | 0.5% |
| Testing possible solutions to the larger class project | 13 | 35% |
| Uncovering assumptions or gaps in knowledge | 4 | 1% |
| Building on pre-existing knowledge basis | 25 | 68% |
| Drawing from the lived experiences of others | 1 | 0% |
| Identifying unknown particulars of the larger class project | 23 | 62% |

*Fig.3, Thematic Analysis of Phase Two Reflective Statement Responses*

| Theme | N | % |
|---|---|---|
| Producing unexpected or new directions for further research | 23 | 62% |
| Generating possible solutions to the larger class project | 7 | 19% |
| Contextualizing or exploring the larger class project | 16 | 43% |
| Decoding or evaluating thinking processes | 11 | 30% |
| Testing possible solutions to the larger class project | 19 | 51% |
| Uncovering assumptions or gaps in knowledge | 24 | 65% |
| Building on pre-existing knowledge basis | 14 | 38% |
| Drawing from the lived experiences of others | 30 | 77% |
| Identifying unknown particulars of the larger class project | 27 | 73% |

*Fig.4, Student Generated Matrix of Question Types*

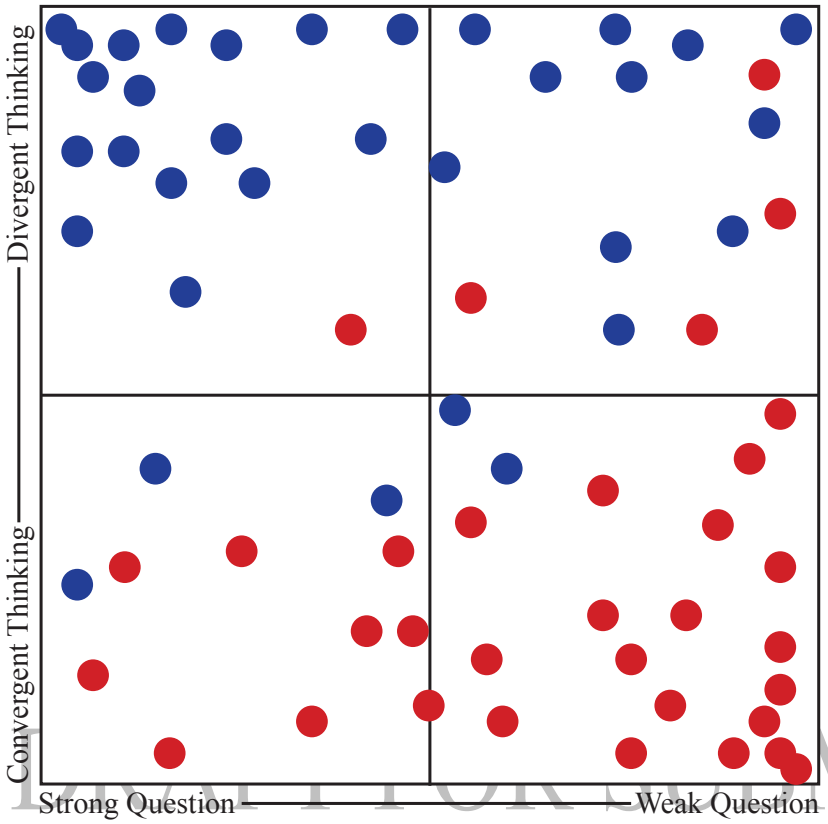

*Fig. 5, Student Generated Matrix of Question Types with Representative Questions*