TRANSFORMING THE CLASSROOM WITH DESIGN THINKING

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Abstract: *Design thinking is not a new concept, but it is a tool that could potentially be very useful in the classroom. It is deeply rooted in the scientific method and works well with the concepts of problem solving as well as critical thinking. It is an especially worthwhile learning method in conjunction with project-based learning. Traditionally the term design thinking might be associated with business and industry, but it is a process that can be practiced in all educational disciplines. Just as with other existing concepts, design thinking is a worthwhile tool that educators can use to help their students be successful in the classroom.*
The core tenets of design thinking are Empathy, Define, Ideate, Prototype, and Test. Each stage of the process allows students to work through a project step by step thereby allowing students to skillfully master a learning process can be used for a variety of projects, in all their classes.
Today's college students are very adept at creating a final project, but many are not aware of the design thinking process and how it can potentially help them be more successful. Far too often students simply go with their first idea to create a project and don't take the time to analyze the steps needed to create a worthwhile project. By sharing the design thinking process as part of a class students will then be able to transfer the five tenets of the process into creating a higher quality final project.
This study began by including the design thinking process in a sophomore level Graphic Communication course and then moved onto including the design thinking process in a senior level Graphic Communication course. Students in both classes were surveyed on their past experiences with the design thinking process, as well as their experience with the five tenets of the process. Both class formats were traditional in-person courses. Students were instructed on how they could use the design thinking process in a classroom project. Upon completion of the project students were then surveyed to find out their overall experiences with the design thinking process. Certain areas of the design thinking process including critique and reflection were emphasized as part of the project in both classes.
This paper will explore the design thinking process though a literature review and how the process was implemented in two university level courses. Student's prior experience with the design thinking process will be examined and student's will be surveyed upon completion of a project based on the design thinking process to explore what elements they enjoyed of the overall process.

Key words: Design Thinking, Project-Based Learning, Critical Thinking, Scientific Method

1. INTRODUCTION

Students enrolled in undergraduate Graphic Communication courses at Clemson University are very aware of the traditional graphic design process. This established process involves three stages of design: thumbnails, roughs, and comprehensives, (Arntson, 2007; & Appiah & Cronjé, 2012). This three-step design process is used throughout the world of art and graphic design, and Graphic Communication students are usually very familiar with using this process when creating a design-based project. Students enrolled in the same undergraduate courses do not appear to be as familiar with the design thinking process and a study was conducted to survey Graphic Communication undergraduate students in two different classes at both the sophomore and senior levels to determine student familiarity with the design thinking process, and to examine how the students enjoyed using the design thinking process to complete a major project.

Pre-project and post-project anonymous online surveys were given to two different classes of students to determine first what their familiarity was with the design thinking process, and then after the projects were completed to get a better understanding of how they enjoyed using the design thinking process, and what stages of the design thinking process were their most liked stages, and if they would use design thinking again for future projects.

The design thinking process includes five core tenets: Empathy, Define, Ideate, Protype, and Test (Figure 1). As part of this learning activity students were provided lecture material and an online module to learn about each of the stages in the process. The online module included links to helpful websites and videos. Classroom discussion was also a major part of the learning process for the students.
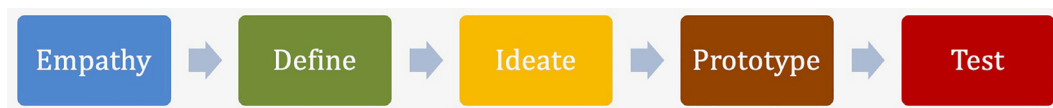
Figure 1: Design Thinking Process

Each stage in the design thinking process has a distinct role, though there is often overlap and revisitation of roles throughout the process. During the Empathy stage the best outcome, product, or service is decided upon. In the case of a classroom project, the best project solution is determined. The next stage is the define stage in which the problem is clearly defined and evaluated. During the ideate stage a wide variety of solutions are determined with lots of brainstorming. In the prototype stage the final creative solution to the problem is created or implemented, and in the final stage of testing, the solution is tested, and feedback is gathered to address any possible revisions (Boguda & Shailaja, 2019). Design thinking is not always linear, and the stages in the process can often be moved here and there, and the process can be repeated until a proper solution is acquired.

2. REVIEW OF LITERATURE

Design thinking is a process used in education and business to create better projects and better products and it has been part of the discussion in academic circles for more than thirty years (Gronman & Lindfors, 2021). It is identified by the five different stages (Figure 1) of Empathy, Define, Ideate, Prototype, and Test (Yilmaz, 2022). Design thinking is an approach to formulating ideas and projects utilizing various stages of development.

The core concept of design thinking is based upon design itself. In order to create better artifacts and better things various stages of design need to be utilized (Koh et al., 2015). The design thinking process takes this idea of design and breaks it into five stages. These five stages allow designers to engage in various interactions to better formulate a final design. For instance, the Empathy stage allows designers the chance to better understand and observe the problem at hand, while the Define stage allows the designer to frame the problem, the Ideate stage allows the designer to explore the possibilities, the Prototype stage allows the designer to make and iterate the problem, and the Test stage allows the designer to gain feedback and implement the final solution (Vanada, 2014).

Design thinking has demonstrated its ability to cross over disciplines and to help create trust between collaborators, foster problem-solving skills, and increase the quality of solutions being generated in the classroom (McLaughlin et al., 2022) Design thinking has also proven to be a valid process across various disciplines and universities.

Educators across disciplines have various levels of familiarity with the design thinking process, though research suggests that integrating design thinking into the curriculum can help achieve competencies like critical thinking, student collaboration, and global awareness (Hennessey & Mueller, 2020). Design thinking has the potential to create collaboration between various disciplines such as art, science, mathematics, and social studies. Educators also perceive the process as a way they could solve problems incorporating a combination of previously acquired skills, learning outcomes, and existing knowledge.

Students in an undergraduate business class were exposed to the design thinking principles through an adaptation of an undergraduate design project (Armstrong, 2016). In this case students followed a nine-step process: (1) Gain initial insights, (2) Build on initial insights, (3) Capture findings and reframe the problem, (4) Craft the problem statement, (5) Ideate solutions to the problem, (6) Share solutions and record feedback, (7) Reflect and generate a new solution to the problem, (8) Create a prototype and record feedback, and (9) Record final feedback. In this manner the five-stages of the design thinking process were broken out into more manageable steps for the students. By following these steps students were exposed to a full cycle of the design process and were able to develop more critical thinking skills that are more in tune with "real-world" applications.

Empathy, holistic view, problem reframing, and team working were all areas of research that were enhanced using the design thinking process (Thi-Huyen, Xuan-Lam & Thanh Tu, 2021). Engineering students were presented with the design thinking process during a month of their course to determine how design thinking could aid in the growth of problem solving and teamwork mindsets. At the end of the month students recognized the importance of developing the best possible solutions, viewing the problems from a holistic view, addressing problems in a new manner, and encouraged students to creatively think of solutions that allowed them to identify the true problem and create possible solutions.

Design thinking can also be broken into four different processes; (1) Creative Problem Solving, (2) Sprint Execution, (3) Creative Confidence, and (4) Innovation of Meaning (Dell'Era et al., 2020). Each of these categories allow individual to better engage in the design thinking process. The first kind, Creative Problem Solving, allows the designer to solve a problem using creative solutions to the known problem. The second category, Sprint Execution, allows the designer to quickly accelerate the development process and allow solutions to be completed faster. The third, Creative Confidence, promotes an approach that aims at promoting a new innovative mindset that fosters a new set of approaches and practices that foster innovation. The fourth kind, Innovation of Meaning, supports new innovative design strategies that support new, and strategic directions that are pursued by the clients. Each of these four kinds of design thinking allows a new framework to be put in place to help foster solutions using the existing design thinking process.

The 5-step IDEAS critical thinking process can also be a part of the design thinking process. The first step, represented by "I", of this process is to "Identify Problems and Set Priorities", the second step represented by "D" is to "Determine Relevant Information and Deepen Understanding." Step three is represented by "E" and is "Enumerate Options and Anticipate Consequences." Step Four is represented "A" and is "Assess the Situation and Make a Preliminary Decision", and step five is represented by "S" and is "Scrutinize the Process and Self-Correct as Needed." It is clear from this five-step critical thinking problem-solving process that design thinking is clearly following a very similar path through its process, (Facione & Gittens, 2016). The design thinking process allows creators the chance to critically think about solutions throughout the entire process.

From a business perspective design thinking has also been shown to be a useful process in project management, (Lahiri, Cormican & Sampaio, 2021). Design thinking allows the designers to emphasize with the customer needs and better understand what the customer wants or desires. Design thinking adopts a user centric process that allows designers to better understand the needs of the customer. Design thinking is also focused on communication as part of the process that allows the customer to communicate more efficiently with the designer.

An interesting take on design thinking is teaching learners how to fail better. The current climate in education is to be successful and doesn't really address the concept of failure. Students need the ability to test ideas in a way that it is messy and a way that can include failure. Design thinking allows students to come up with concepts that may inherently be failures but may be successes when feedback is received from their peers and they are given the chance to create a successful concept that has been tested, revised, and edited based upon feedback from their peers and their teachers, (Long, 2012).

Related methods to design thinking include participatory design, bricolage or tinkering, making, and Lego Serious Play (LSP). All of these methods also include a system of discovery though each approaches the process differently from design thinking (Panke, 2019).

3. METHODOLOGY

A research study was created to examine the extent to which undergraduate students, enrolled in classes within the Department of Graphic Communication, were familiar with the design thinking process and to determine what they thought of using the design thinking process to complete a major project. In addition to quantitatively surveying the students anonymously on the design thinking process, an online module and lecture material were created and shared with students to help inform them of the design thinking process.

Two different undergraduate classes within the Department of Graphic Communication were selected to be a part of this study. The researcher worked with the Institutional Review Board (IRB) at Clemson University to design a valid study that provided anonymity to all students who took the surveys. The IRB reviewed the pre and post surveys and approved the use of human subjects as part of this study.

The first step in conducting this study was to give the pre-design thinking project survey to the students enrolled in a sophomore level Graphic Communication course, GC 2070. This pre- survey was given to the students before any mention of the terms design thinking process. Upon completion of this pre-project survey students were informed that the class would be using the design thinking process to complete a portfolio project that highlighted student design work. The students were given a lecture on the process and provided an online module within the Course Management System that provided additional information on the design thinking process. This additional online information included website links and video links. After reviewing the process, students then completed their portfolio project using the five stages of the design thinking process. Students engaged in discussion with their classmates during each of

the five design thinking stages and used feedback from their classmates to make a better project. The professor did not provide any feedback on the projects during this aspect of the project. Upon completion of the portfolio project students took a post-project survey to analyze their basic thoughts on the use of the design thinking process to complete their portfolio project.

The second step in conducting this study was to give the pre-design thinking project survey to the students enrolled in a senior level Graphic Communication course, GC 4440. Just as the students did in the sophomore class, students in the senior class took the initial pre-project survey without any introduction to the design thinking process. For the senior level class, students utilized the design thinking process to complete a portfolio project focused on creating sustainable packaging. After completing the pre-project survey, students in GC 4440 were given a lecture on the design thinking process and then provided an electronic module of information covering the design thinking process. This material also included websites and videos just like what was shared with the lower-level course. Upon completion of this portfolio project, students completed a post-project survey.

Both of the classes took the same pre and post surveys. Each class was also given the same lecture material and provided the same information in an online module provided within Canvas, the Course Management System for each class. Since the classes were at the sophomore level and the senior level it was decided not to give each class the same project, so a design portfolio project was designed for the sophomore level class, while a sustainable package portfolio project was created for the senior level class. While this did have each class create different final projects, they both followed the same learning process.

The surveys were administered to the sophomore level class in the Fall of 2021, while the surveys for the senior level class were administered in the Fall of 2022. Each class consisted of unique students and there were no students who took the sophomore class and completed the study, and then went onto to complete the study in the senior level class a year later.

Data for this survey was collected via Canvas, the online classroom portal provided by Clemson University. Students had to be enrolled in the course in order to access the surveys within the course management system. Students were not required to take this survey during class but could take the survey on their own time. Because of the anonymity of the survey responses, no student names were tied to survey responses, though the instructor could see the total number of respondents, and how the responses from each respondent.

4. RESULTS

Results of this study indicated the majority of students in both courses were not familiar with the design thinking process (Figure 2 and Figure 3) The study also found that the majority of students in both classes were open to using the design theory process for future projects. Detailed analysis of the survey responses is included below.

In the sophomore level class (GC 2070), 72% of the students had never heard of the design thinking process (Figure 2), while in the senior level class (GC 4440), 71% of the students (Figure 3) had never heard of the design thinking process. There were 47 respondents for GC 2070 there were 28 respondents for GC 4440).
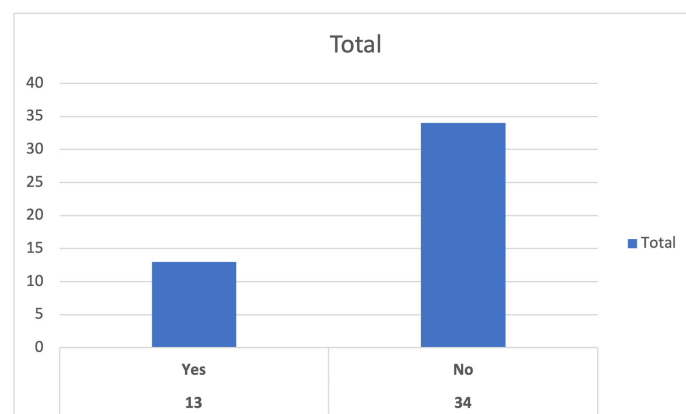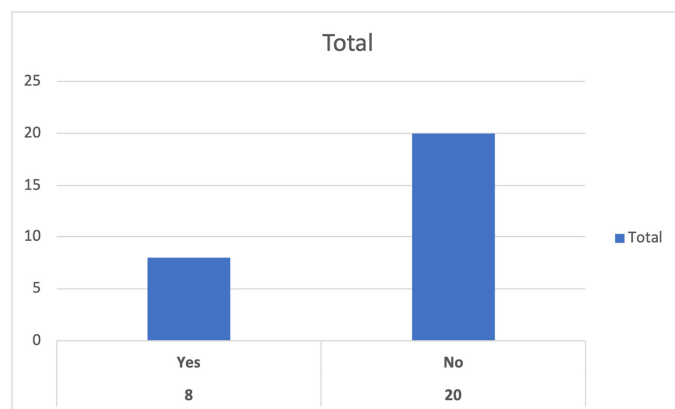

*Figure 2: Have you ever heard of the design thinking process? (GC 2070 Responses)*

Figure 3: Have you ever heard of the design thinking process? (GC 4440 Responses)

Upon completion of the project that utilized the design thinking process students were again surveyed using the same online survey system. In the sophomore level class (GC 2070) 92% of the respondents where either satisfied or very satisfied with the process (Figure 4). Only two respondents were neutral to the process while only one was very unsatisfied with the process.
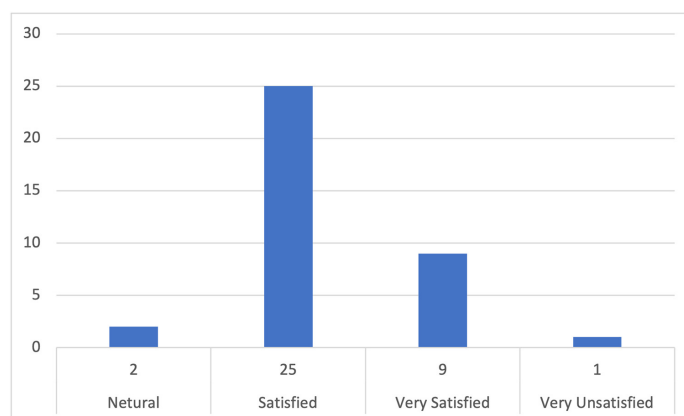

Figure 4: Overall, how satisfied were you with using the design thinking process to complete your portfolio project? (GC 2070 Responses)

Students in the senior level course (GC 4440) were also satisfied with using the design thinking process. 65% of the respondents indicated they were either satisfied or very satisfied with the process (Figure5). Seven students were neutral to the process. In the senior level course, no students responded to be unsatisfied in the process.
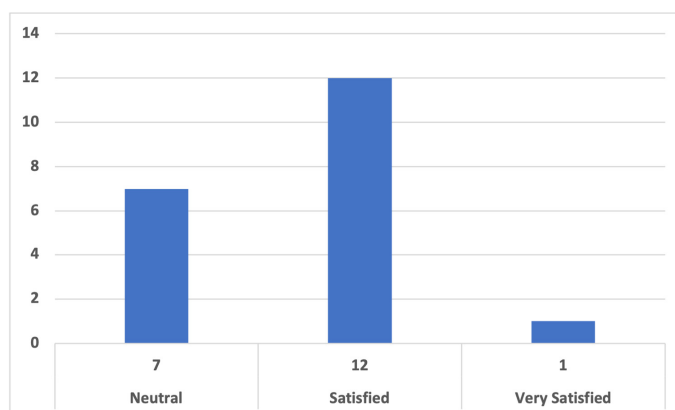

Figure 5: Overall, how satisfied were you with using the design thinking process to complete your portfolio project? (GC 4440 Responses)

Students were also asked if they would use the complete design thinking process for future projects. 74% of the respondents in GC 2070 indicated they were likely or most likely to use the complete overall design thinking process for future projects (Figure 6.). Respondents in the GC 4440 also indicated they would likely or most likely use the complete process with 60% of the respondents indicated they would likely or most likely use the complete process for future projects (Figure 7). Six students were neutral to using the complete process in the future in the sophomore level class, while five students were neutral to using the complete process in the senior level class. One respondent stated they would unlikely use the complete process in the GC 2070 course, while three respondents indicated they would not likely use the complete process in the GC 4440 course.
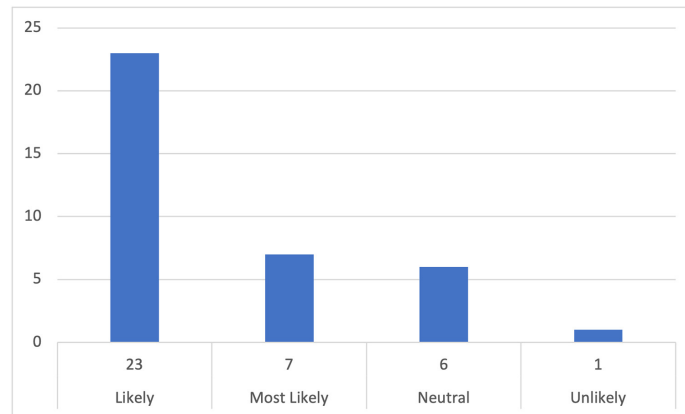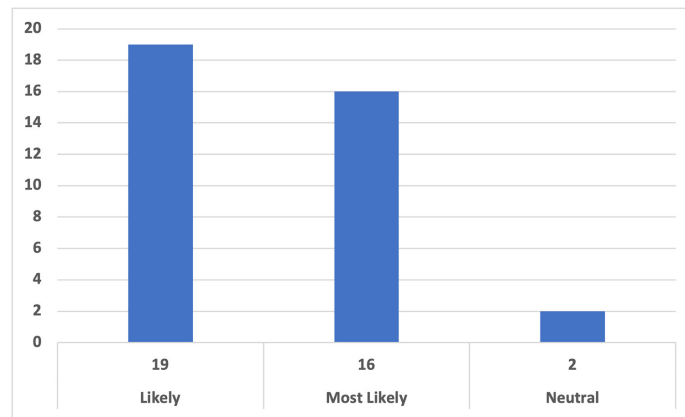

Figure 6: How likely are you to use the complete overall design thinking process to complete future projects? (GC 2070 Responses)
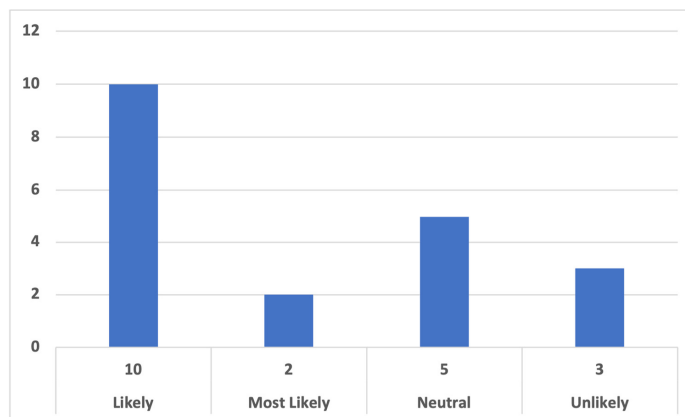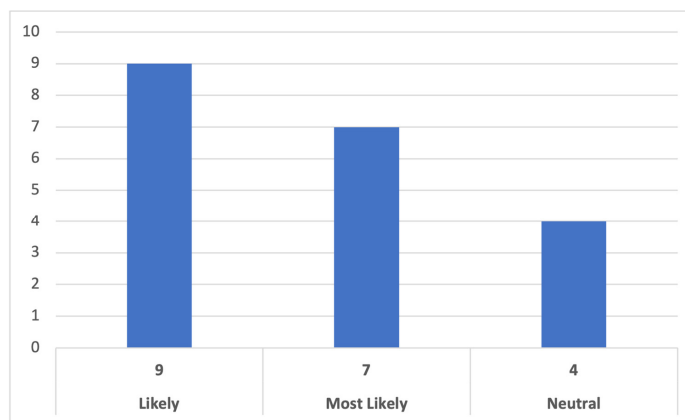

Figure 7: How likely are you to use the complete overall design thinking process to complete future projects? (GC 4440 Responses)

When asked about using parts of the design thinking process for future projects both classes overwhelmingly indicated they would be open to using parts of the process. 95% of the respondents in the GC 2070 course indicated they would be open to using parts of the process (Figure 8) while 80% of the respondents indicated they would be open to using parts of the process in the GC 4440 course (Figure 9). No students in either class reported they would unlikely or least likely to use elements of the overall design thinking process.

Figure 8: How likely are you to use parts of the design thinking process to complete future projects? (GC 2070 Responses)


Figure 9: How likely are you to use parts of the design thinking process to complete future projects? (GC 4440 Responses)

Respondents in both courses had different opinions about what part of the design thinking process they liked the most, though both classes indicated their favourite two processes were Ideate and Prototype. In GC 2070, the majority of respondents (Figure 10) indicated they liked the Ideate stage the most, while in the GC 4440 the equal number of students liked the Ideate and Prototype stages (Figure 11). The Prototype stage was second in responses in the GC 2070 course. The least liked stage in the GC 2070 course was the Test stage, while Define and Emphasis were the least liked in the GC 4440 course.
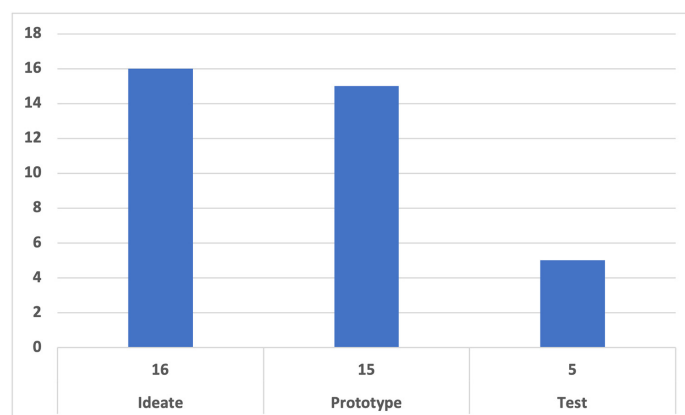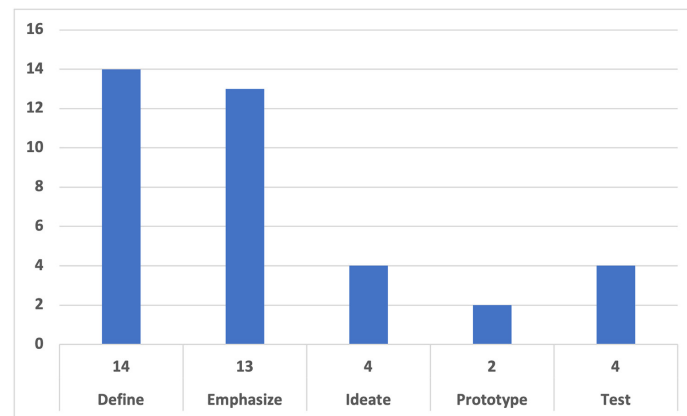

Figure 10: Which part of the design thinking process did you like the most? (GC 2070 Responses)
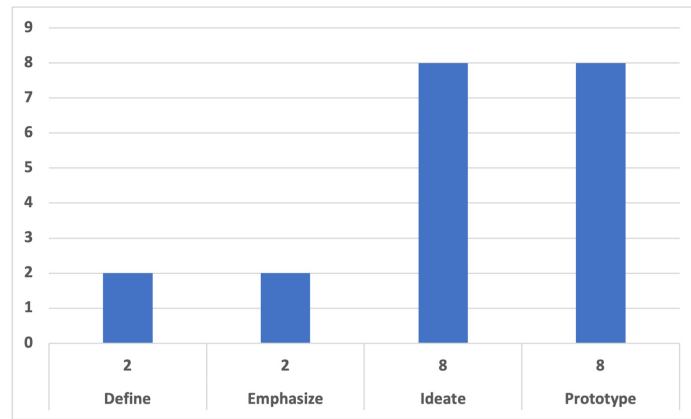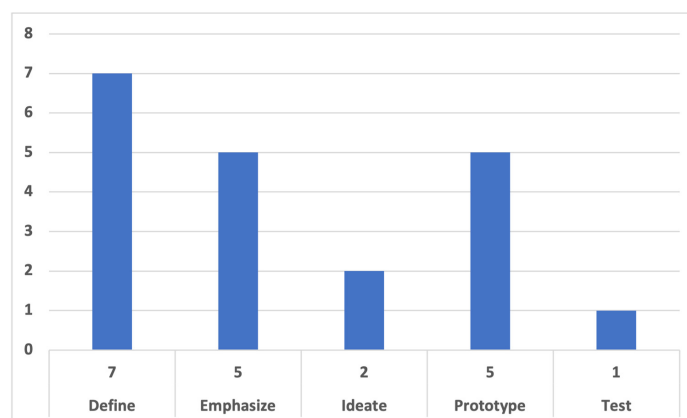
Figure 11: Which part of the design thinking process did you like the most? (GC 4440 Responses)

Students in the GC 2070 course overwhelmingly (73%) indicated their least liked part of the process was the Define and Emphasize (Figure 12). While students in the GC 4440 course indicated the least liked part of the process was the Define stage, followed closely by the Emphasize and the Prototype stages (Figure 13).

Figure 12: Which part of the design thinking process did you like the least? (GC 2070 Responses)

Figure 13: Which part of the design thinking process did you like the least (GC 4440 Responses)

In examining the data from the survey questions regarding most liked and least liked stages, it is interesting to note that while both classes had similar responses, they also had differing experiences with the design thinking process, and what their least favourite part of process was.

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Results of this study indicate most students surveyed were not aware of the design thinking process to begin with but are open to using the entire design thinking process or at least parts of the process for future projects.

5. LIMITATIONS

This study is limited in scope to undergraduate students that were enrolled in a sophomore and a senior level course within the Department of Graphic Communications that were taught by Dr. Charles Weiss. The findings of this study are therefore limited to students enrolled in these two courses and should not be applied to other classes directly. It is possible however to take these results as an indicator that the design thinking process can be used to enhance the curriculum of other undergraduate courses, in other departments and other universities, but further research will need to be completed in order to find the experiences of students in other classes and other Departments on campus.

6. CONCLUSIONS

The design thinking process has been a part of the educational curriculum for the past thirty years, but this study clearly indicates the majority of undergraduate students who participated in this study were not aware of, nor had heard of the process. This also indicates other teachers the students may have had in high school and university have not been incorporating this concept as part of the learning process. So, while the design thinking process has the potential to provide positive benefits to the curriculum for any class that utilizes project-based learning, it is essential for educators to teach students more about the process and to do what they can to incorporate it as part of classroom projects.

If the design thinking process is going to play a larger part in the curriculum within the Department of Graphic Communication, and potentially other departments or other universities, more projects need to be created that incorporate the design thinking process. More time needs to be spent showing students the details of using the design thinking process, and the potential of using the complete or even aspects of the process as part of their learning journey.

Students also need to learn that their first idea is not always their best idea. Critique and feedback are part of life and that is the same for classroom projects. The design thinking process allows students the chance to fail and to make something stronger based on feedback from their peers.

7. RECOMMENDATIONS

The design thinking process can transform project-based learning in the classroom, and help students create better projects, while also teaching students the benefits of constructive feedback shared in a dynamic process that is focused on success. Educators and students need to understand the process and start to explore the benefits of the five core tenets.

While the design thinking process is generally made up of five different stages it is important for educators to define each of those stages for their own classroom. Some educators may choose to only use some of the tenets while other educators use all. The adoption of this process is up to the educator, and they must be able to adopt it in a way that works for their classroom. This is also evidenced by some of the reviewed literature as it is easily possible to modify those five stages to create a better fit for the curriculum model being used for a specific project, or in a specific field or classroom.

Design thinking is not a new concept, but it is a concept that seems to be underutilized in the classroom. Educators and students alike could benefit from incorporating more design thinking into projects and curriculum initiatives. More research needs to be conducted so that more information, and suggestions, on design thinking can be shared with a larger academic population.

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