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TEACHING PROBLEMATIZATION OF A DESIGN CAPSTONE PROJECT: PRESENTATION OF A PEDAGOGICAL TOOL

Sébastien Proulx, *The Ohio State University*

The research phase preluding a design capstone project is challenging for both students and instructors. In a situation where students are free to work on a topic of their choosing, a preset, generic research design is not suitable. Imposing a rigid framework would endanger the possibility of students truly examining and capturing the complexity of their project problematic. This would also be considered a counterpoint to the learning goal of teaching students how to engage in problematization, a skill highly valued in contemporary design practice. This reality raises the following question: how are instructors supposed to monitor and support students in this process? To address this problem, a teaching assignment called the *Newspaper* was designed. The *Newspaper* is an open and flexible framework, based on a digital platform, through which students can organize their research findings and reflections, while ensuring enough flexibility for students to deploy appropriate and relevant research methods. This assignment gives students freedom in terms of their research design, but also has certain constraints to ensure the intelligibility of the research process. This paper presents the *Newspaper* assignment in detail and discusses its impacts after it is used by three cohorts of industrial design students.

Sébastien Proulx is Associate Professor in the Department of Design at The Ohio State University. He is the coordinator for the Industrial Design major and Co-Director of the Ohio State DESIS Lab. His research program revolves around the role of designers in the development of public services and policies.

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INTRODUCTION

In the various areas of design education[1], the senior thesis or capstone project[2] often represents the last milestone that students must overcome before graduating (Dutson et al., 1997). In many programs, the capstone project makes up a significant portion of the credit hours of the final year's design-related courses. Students see the capstone project as an opportunity to boost their personal portfolios with a substantial project of which they can claim ownership from problem identification to realization. Students also hope that the public exhibit of the project may attract the interest of potential employers and provide them with job opportunities. Whether or not these expectations are legitimate is up for discussion. Beyond students' enthusiasm about fulfilling their personal portfolios, the capstone project remains a pedagogical activity attached to learning objectives and outcomes. It is an activity that presents numerous challenges for both the instructor and the students.

As students can work on various types of projects, one of the great challenges facing instructors tasked with teaching senior capstone is managing the diversity of topics without forcing students into an unfitted and standardized structure or process. This is especially important for the quality of the problematization effort, as different topics call for different research designs and methodologies (Harfield, 2007). In other words, assisting the diversity of student projects calls for the adoption of a flexible pedagogy strategy (Ryan & Tilbury, 2013).

To ease the problematization process, an assignment called the *Newspaper* was engineered to provide students with a flexible framework around which they can structure their research efforts. I designed this assignment with the aim to support students in pursuing specific research endeavors while maintaining my capacity, as the instructor, to track

[1] Design is understood here from a broad and open perspective encompassing all design-related fields. To the typical industrial, interior, and graphic design fields we add disciplines such as architecture, landscape architecture, and urbanism, which share the same conceptual roots.

[2] The notions of *senior thesis* and *capstone* are here used interchangeably.

individual progress. The architecture of the assignment is analogically modeled on the structure of newspapers with topical sections. The goal of the assignment is to help students curate and organize research findings and facilitate the adoption of a reflective and analytical mindset. This paper presents the assignment and discusses the impact I noticed after experimenting its use with three cohorts of undergraduate senior industrial design students.[3] Through the presentation of this assignment, I aim to discuss a potential avenue to inspire reflection on the embracement of flexible yet rigorous teaching strategies in design education.

BACKGROUND

The Capstone Project

The capstone project is a common pedagogical approach in contemporary higher education (Hauhart & Grahe, 2015). Across disciplines, from sociology to chemistry, capstones are valued for providing students with a complex learning setting. This type of learning activity offers a context in which students can demonstrate mastery of the theoretical knowledge they learned, the technics and methods they acquired, as well as the attitudes and practical competencies they developed throughout their studies. In other words, the capstone project is a synthetic pedagogical strategy that allows students the opportunity to consolidate their learning and demonstrate that they are ready to graduate (Berheide, 2001).

The Capstone Project in Design Education

In the context of design, the tradition of relying on the capstone can be traced back to the 19th-century Beaux-Arts model of education in arts and architecture (Carlhian, 1979). In the Beaux-Arts tradition, the educational pathway culminated with the *épreuve terminale,* the final test. For the *épreuve terminale* in architecture, for instance, students had to design an answer to a specific challenge where they had to demonstrate mastery of certain knowledge and technics, as well as creativity. Although early 20th-century art and design schools, such as the Bauhaus, rejected the aesthetic and philosophical tenets of the Beaux-Arts school (Findeli, 1994), the successful completion of a self-guided final project for graduation remained the norm.

Typically, this activity tends to put a lot of emphasis on the final output of the project. This resonates well with students' eagerness to add a showstopper project to their portfolios. However, from a pedagogical standpoint, the focus on the final outcome can become a major pitfall. When the light only shines on the outcome, the process becomes a mere means to an end; the intellectual effort that was put into the development process is devaluated and not appreciated as a meaningful deliverable. This is problematic for many reasons. For one, overlooking the different components preceding the end result reduces the capacity to assess students' work ethic or appreciate skills that do not obviously percolate in the end result (Palomba & Banta, 1999).

As the design discipline developed, contemporary design educators started considering the journey, from a pedagogical perspective, as the genuine focus of the capstone project. Paying attention to the design process renders the capacity to assess and appreciate students' decision-making logic (Sheppard et al., 1997).

Putting aside the specifics related to particular project topics, the general process of the capstone, at least in the context of industrial design, almost always follows the same canonical two-phase model: research > execution (Proulx, Gauthier & Hamarat, 2020). However, this administrative distinction between the two phases is a false representation of reality. It would be inaccurate not to recognize that there is always some back and forth between the two phases. For example, as students delve into project development, new challenges are bound to emerge, sparking the need to conduct targeted research to fill knowledge gaps. Despite the need to acknowledge the blurry line between the two phases, it is still worthwhile to distinguish them on the grounds of the horizon that each one pursues.

Problematization of the Project

During the first phase, students engage in a research endeavor, trying to understand and define the problematic situation around which their chosen topic revolves. This research phase must allow students to uncover central issues and stakeholders to account for and review the existing body of knowledge about the topic. This form of conceptual endeavor corresponds to the concept of problematization (Fabre, 2017; Findeli, 2001). In a nutshell, problematizing entails conceptualizing a situation, much like the background section of this paper tries to articulate the conceptual constructs that are presented in the following section.

> *We speak of a problematic to indicate the development of a question or problem. Let's say that constructing a problematic consists of developing a problem statement (Fabre, 2017, p. 13).*[4]

The research phase culminates in a review during which students present the information they have gathered, forge a *project statement,* and define an effective design brief meant to frame the execution phase of the capstone. As such, the second phase centers on developing a design proposal that reflects the problematization of the situation.

[3] As the research is set in the Usonian context, the senior year typically refers to the fourth and final year of the program.

[4] Author's translation from French: «on parle d'une problématique pour indiquer le développement d'une question ou d'un problème. Disons que construire une problématique consiste à élaborer un énoncé de problème.»

The Industrial Design Capstone Project at The Ohio State University

As the instructor in charge of teaching the capstone project of the industrial design undergraduate major at a large, Usonian, research-intensive public university (R1), I supervise 15 to 18 capstone projects annually. The way the capstone course is currently structured allows students to choose their own project topics, as long as they are based on an open-ended premise (the answer cannot be known in advance). In other words, a student is allowed to work on urban active mobility but not on the design of an electric urban bicycle, although it may eventually lead to that point. This constraint ensures that students understand that problematization is an integral and valuable part of the project.

In our program, the research phase is the topic of a standalone course called *Design Research III* (DR3).[5] This studio course is the third installment of a course series where students develop and demonstrate design research skills. In the syllabus provided to students, the goals of the course are presented in the following way:

> *In this project-based course students are to experiment with traditional and innovative research methods to develop their senior thesis proposal. Through the examination of a problematic situation of their choosing, students demonstrate the skills they acquired through their previous studies in regard to design research, problem diagnosis, opportunity identification and exploration, and drafting of a design brief and a project proposal. At the conclusion of this sequence, students have gathered information and explored opportunities allowing them to author a clear design brief and establish a well laid out strategic project development plan for the execution phase that follows. (Proulx, 2020)*

The course objectives emphasize the importance of the design process. To support students through the research phase and structure the assessment, a series of distinct assignments were devised (see Table 1).

Navigating the Challenges Attached to Problematizing Efforts

Although the situation can vary from program to program, it is common for students to be given the opportunity to choose their project topic. This liberty offered to students renders the research phase an essential part of the process. However, this comes with significant challenges that both students and instructors need to navigate.

For students, keeping the project horizon open can quickly spark a feeling of vertigo. I commonly observe students becoming overwhelmed or even anxious when they do not know how to manage the complexity revealed by lifting the curtain off the situation they wish to have their project revolve around. This is exacerbated by the fact that students cannot be specifically told how to dive into the problematization of their project. Because each project is essentially singular, it would be ill-advised for the instructor to be overly prescriptive on the pedagogical design front. Forcing all students into a strict research design is methodologically and pedagogically misguided. Indeed, among the learning outcomes of the capstone project, there is the objective to see that students can, on their own, methodically explore and analyze a situation. This twofold challenge therefore raises the question of how to facilitate the pursuit of a rigorous research process without forcing students into an unfitted research design. At the same time, it is unreasonable to expect instructors to individually tailor their teaching strategies. This need for leniency calls for the adoption of flexible learning strategies. Flexible learning is a broad concept that refers to teaching strategies that expand choices and opportunities to improve the student learning experience.

ASSIGNMENTS	VALUE
Senior Thesis Topic Proposal	Pass or Fail
Research Dossier (Newspaper)	50%
Research Review	25%
Reading Quizzes	10%
Formative Assessment	15%

TABLE 1. Design Research III course deliverables.

> *Flexible learning is a movement away from a situation in which key decisions about learning dimensions are made in advance by the instructor or institution, toward a situation where the learner has a range of options from which to choose with respect to these key dimensions. (Collis & Moonen, 2002, p. 218-220)*

Another challenge that instructors need to navigate is defining the scope of their role and the nature of their interaction with students. In a context where students can choose their topic, it might well turn out that the instructor does not have the expertise to substantially support students. However, even in the case where the instructor has good knowledge of the topic, because of the pedagogical nature and the aim of the capstone project, he or she must refrain from over-involvement to avoid leading students to his or her perspective. This need to limit the instructor's involvement is tied to the learning objectives of developing students' autonomy and decision-making skills.

The third type of challenge for the instructor is tied to the need to track students' progress and make them accountable for the information they gather. This challenge also manifests

[5] The second phase is the topic of another course (Advanced Industrial Design I), making the senior capstone a total of six credit hours.

on the student side of things in the question of how to ensure that the body of research informs decision-making during the execution phase. Too often, I see students researching or reading something central to their problem, only to later leave the information aside because they forget about it or, worse, do not feel that it will fit in with where they would like to see their project go. To ensure a robust and rigorous project development process, it is essential for students to be made accountable for their research findings. Accountability for data, as a dimension of *phronesis,* has to be considered an imperative to a genuine, ethical, and virtuous expression of expertise (De Caro et al., 2018) Accountability is valued in a professional attitude. This is especially important at this moment in the history of design as the scope and boundaries of the field are rapidly expanding to include more strategic and executive responsibilities (Muratowski, 2015).

To summarize, from a pedagogical perspective, the problematization of an industrial design capstone raises many challenges that instructors and students need to navigate:

- How can instructors empower students to freely explore a problematic situation without making them feel overwhelmed by complexity?
- How can instructors facilitate student adoption of a methodologically fitted research design without having to adopt an individually tailored mode of instruction?
- How can instructors keep track of and assess students' process and progress?
- How can instructors support students in being accountable for their research findings?

STRUCTURING THE RESEARCH PHASE OF THE CAPSTONE PROJECT

After being involved in teaching and advising senior capstones for more than 15 years and see myself struggling at keeping up with students' various project orientations, I was looking for a better way to accompany students on their journey. I looked for tools or frameworks to find that not many were shared publicly or sufficiently documented and vetted to engage with them. Moreover, I considered approaches I was able to find to be too rigid to worked with the conceptual underlying of my courses goals and pedagogical objectives. To support students in the exploration of their problem space and to alleviate the four challenges listed above, I set out to design a flexible framework analogically modeled on the structure of a newspaper with thematic sections was developed. This framework is embodied in an assignment I called the *Newspaper*. As a framework this assignment allows students to conduct research and share their findings in a logical and organized way.

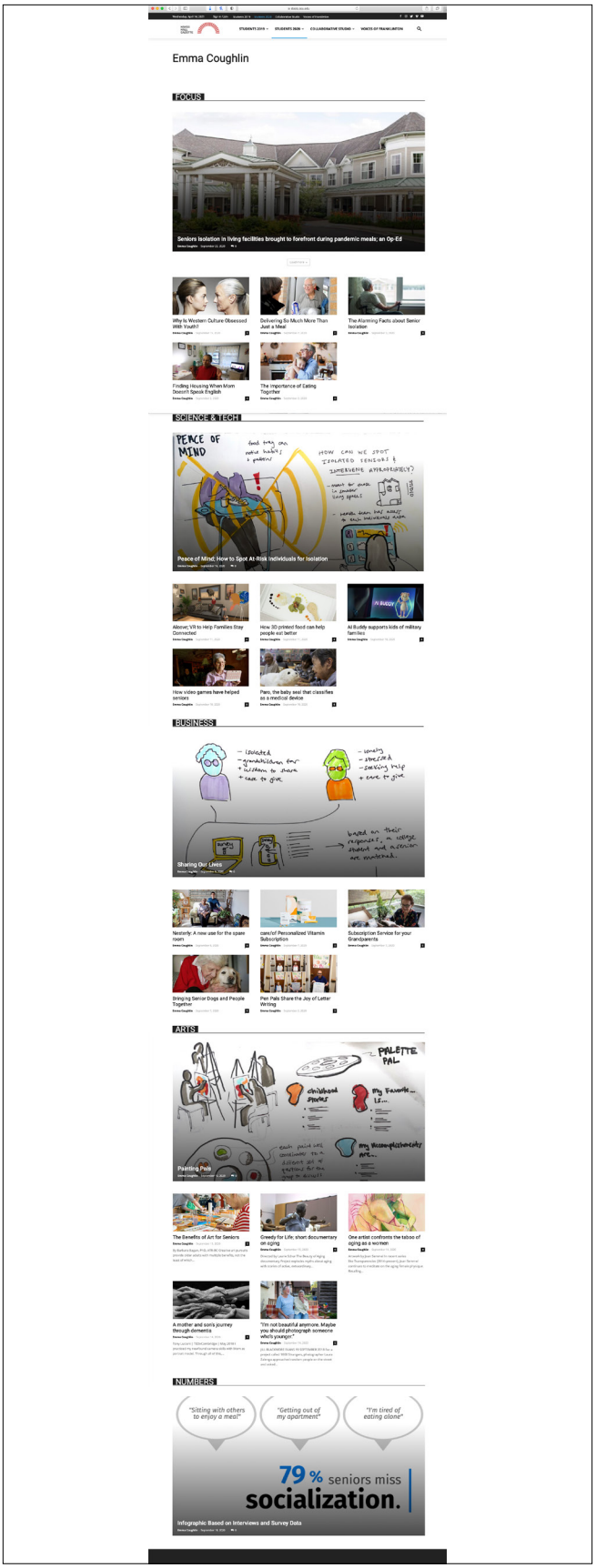


FIGURE 1. Template of the *Newspaper*.

Formalizing a Conceptual Framework.

As the goal of this assignment is to support students' focus on research, I designed an accompanying web-based digital platform to streamline the process of completing the various components of the assignment. The platform is configured on a customized WordPress template (see Figure 1) I developed with the help of qualified graduate students.[6]

A decision to rely on a digital platform to structure the assignment was made after experimenting with a paper-based *Newspaper* format during the first year (See Figure 2). Although romantic in it is delivered form, relying on the paper-based platform was deemed ineffective because it did require students to have a fairly good knowledge of *Adobe InDesign* software to complete the assignment. Although most design students can navigate professional page layout software with relative ease, the type of manipulation needed to use the template properly was too intricate, which ultimately diverted time away from students conducting their research.

To overcome this hurdle, a grant was obtained to support the development of a digital version of the *Newspaper*. Awarded by the Ohio State Office of Distance Education and E-Learning (ODEE) through the Affordable Learning Exchange (ALX) program, this grant made it possible to develop a more efficient platform that also reduces the cost to students by removing the fees associated to printing the *Newspaper*. I decided on Wordpress as the platform for its ease of use and its capacity to work across different types of devices (PC, tablet and even smart phone). This was an important issue for me to consider, as I was aiming to fold this course into our University instated Digital Flagship program. A program that as been providing iPad digital tablet to all incoming new students to the University. In developing the assignment on Wordpress, I was allowing students to make use of the device provided to them, without requiring me to engage on the development of a costly proprietary IOS App base platform.

Although Wordpress may seem complicated at first, it has an easy learning curve. Moreover, a demonstration takes place in class following the presentation of the assignment to introduce students to the manipulation of the platform. Moreover, recorded videos have been made available on the course Content Management System (CANVAS) to provide access to demonstrations around specific manipulation beyond classes hours.

FIGURE 2. Early print-based version of the *Newspaper*.

[6] The Wordpress template is derived from the commercially available theme "Newspaper" by tagDiv.

	TYPE OF CONTENT				
SECTIONS	**OP-ED**	**VOICES**	**LIT REVIEW**	**CONJECTURES**	**SURVEY**
Focus	**x**	**o**	**x**	**x**	
Science & Technology		**o**	**x**	**x**	
Arts		**o**	**x**	**x**	
Business		**o**	**x**	**x**	
Numbers					**x**

FIGURE 3. Schematic mapping of the Newspaper articulation of sections and contents. (x: Must be present; o: could be present)

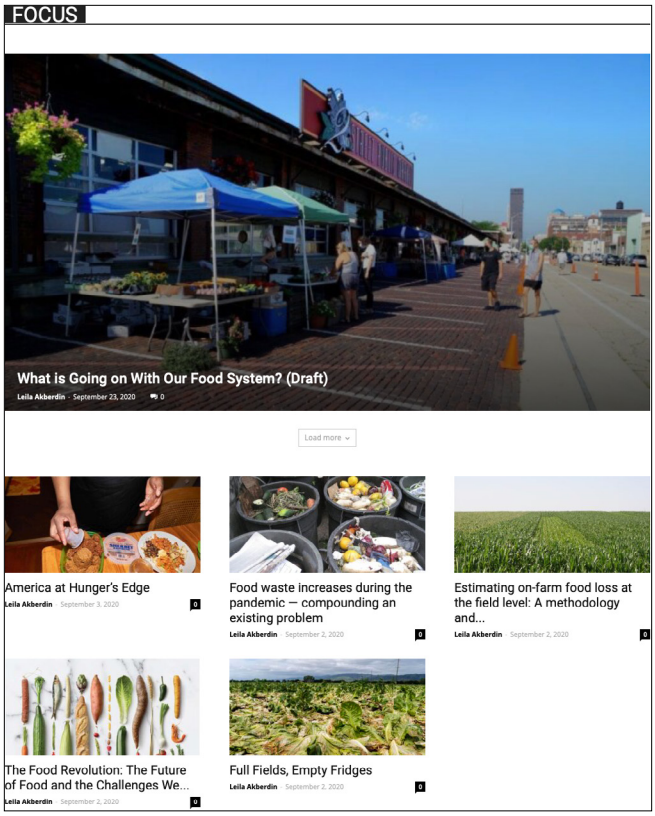


FIGURE 4. Example of a student Focus section landing page.

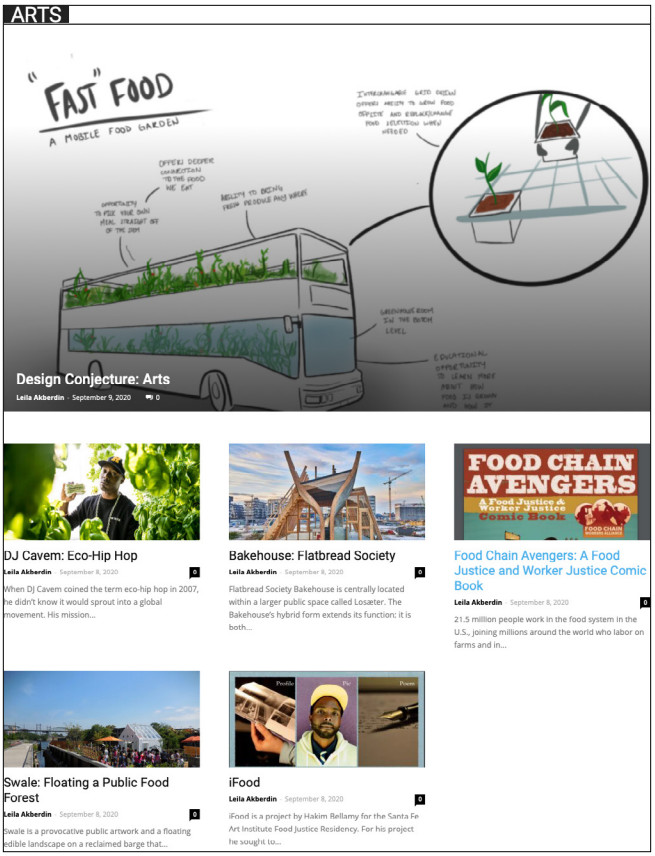


FIGURE 5. Example of a student Arts section landing page.

The *Newspaper* is divided into five sections: 1. Focus, 2. Arts, 3. Business, 4. Science & Technology, and 5. Numbers. For each section, students generate or curate content meeting certain objectives. Although the front-end of the assignment is structured around five topical sections, there is also a back-end that provides students with a flexible framework to develop appropriate content for each of the five sections. Although specific types of content vary in accordance with the nature of each project, all students are required to cover six types of information: 1. primary research, 2. secondary research from a literature review, 3. design conjectures, 4. survey, 5. expert interviews, and 6. secondary demographic data (see Figure 3).

Together, these activities support students in the problematization of their project and provide the instructor with a lean way to keep track of what each individual student is working on. Moreover, as the *Newspaper* structures students' research findings and gives them an easy way to revisit their findings, this framework supports students' accountability.

Sections of the *Newspaper*

Because the students have relative freedom regarding their project topic, it is important for me to provide them with a framework that does not limit their capacity to investigate areas and access important and relevant information. Accordingly, the conceptual architecture of the *Newspaper* is based on the four dimensions defined by Alain Findeli's (1994) design cosmology.

> *In the present framework I propose to distinguish four worlds: the technocosm, the biocosm, the sociocosm, and the semiocosm. The first is the world of artifacts […], i.e. the built environment. The second is the natural environment, that of ecologists; it includes the world of physical geography (mountains, rivers, seas, clouds, etc.) and the plant and animal worlds. The third is that of human geography, of ethnology and sociology, i.e. the whole of human collectivities. The fourth includes the symbolic world, that of meanings, i.e. the world of culture in the broad sense, or, more precisely, the religious world in the most secular sense of the term. (Findeli, 1994, p. 55)*

Accordingly, I devised The *Newspaper*'s sections to support students in exploring how their personal projects cover these different conceptual realms. The topical sections that make up the *Newspaper, therefore,* ensure that students touch on and are exposed to issues pertaining to those five dimensions. Below, each section and its goals are presented.

Focus

The Focus section is the primary and central section of the *Newspaper*. It is the one to which students devote most of

their effort. This section serves as the drop-off point for their individually defined research endeavor. Moreover, the Focus section curates contents demonstrating the scope of the problem. Compared to the other sections, Focus is thought to lead to general and comprehensive analysis. To populate this section, students collect contents that discuss a range of perspectives on the issues and stakeholders pertaining to their research topic. Students use this section to establish background information that points toward the issues at stake and that carries the voices of different stakeholders. In curating the content of this section, students are expected to demonstrate their capacity to articulate the issues that emerged in the other sections of the *Newspaper*.

Regarding types of content, this section includes an op-ed, a design conjecture, and a literature review of at least five articles. The selection of articles must be in line with the generalist and synthetical aim of the Focus section.

Arts

The Arts section hosts information meant to broaden students' awareness of socio-cultural issues related to their problem. Students are asked to populate this section with artworks of any genre (visual arts, poetry, plays, music, books) from any era. The content in this section provides information about qualitative issues and feeds aesthetic insights. In completing this section, students expand their understanding of the issues of both the socio- and semio-cosms.

To complete the Arts section, as is the case for Business and Science & Technology, students must develop a topically relevant design conjecture, an art-driven one in this context, and include a minimum of five articles in the literature review.

Business

For the Business section, students explore cases of successful or failed ventures providing insights into the dynamics of an industry. This section is an opportunity for students to investigate how different business models can reveal realities and issues in the economy and the market. The exploration of innovative business models is also meant to help students reflect on or rethink the scope or nature of a possible design intervention.

Science & Technology

The Science & Technology section serves as a place to collect and engage in a form of precedent analysis. In this section students focus on tangible technologies or projects developed that support the understanding of how technological innovation can be leveraged. However, students are encouraged to consider strategies that were developed beyond the traditional boundaries of design. Through this section, students expand their understanding of both the bio- and technocosms.

FIGURE 6. Example of a student Business section landing page.

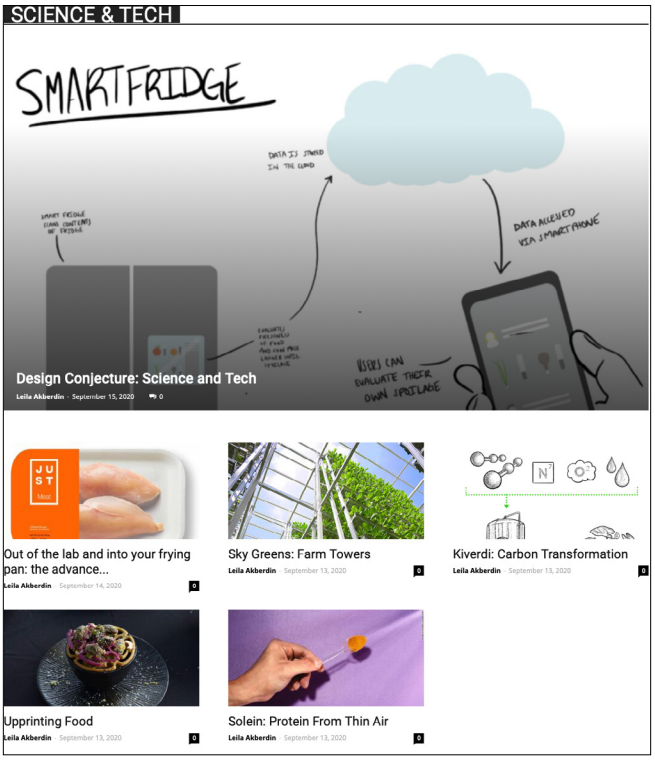


FIGURE 7. Example of a student Science & Technology section landing page.

FIGURE 8. Example of a student Number page.

The Big Problem

In a narrative form, explain the general topic of your project.

**Present the sandbox in which you are playing.*

Specific Questions

- In bullet point format, list specific questions that you feel need to be answered.

Research Methods

- For each question, provide a description of the method you are considering using to gather information. The description should include specific details about the mechanics, justification for the sampling strategy, and the indicators and benchmark metrics you are going to seek for analysis purposes.

FIGURE 9. Research plan template provided to students.

Number

The Number section differs from the others in that it is dedicated to the presentation of quantitative information. To fulfill this section, students prepare an infographic from the results of a survey and up to ten demographic data points gathered through relevant secondary sources. Moreover, beyond presenting statistical or demographic information, students must develop a compelling presentation using visual storytelling methods to express an analytical view of the dataset.

Type of Content

The four sections of the *Newspaper* serve as a framework to assist students in organizing and curating content. However, the body of work associated with completing this assignment is tied to research efforts, from information gathering to analytical reflection.

Primary Research

The central research effort deployed through this assignment is tied to students conducting a firsthand investigation into a problematic situation of their choice. Students are free to include various design-specific forms of analysis, such as user journey maps or service blueprints. Students are free to rely on the research methods of their choice to investigate their project topics, as long as they are grounded in qualitative methodology.

Before they launch their research, students have to provide the instructor with a detailed research plan. This research plan has to list general and specific questions, present envisioned research methods, and discuss their justification.

The research plan must also address the sampling strategy. Students are also required to think about contingencies. To facilitate this undertaking, students are provided with a research plan template (see Figure 3).

This firsthand research effort is presented in the form of an op-ed article that student's integrate as the central feature piece of the Focus section. This article (around 1,500 words + images) is where students present their problem. The instruction they receive is to use this article to describe the context, issues, stakeholders, and interrelationships between these three. This part of the assignment is the most time consuming. To allow enough time to fully explore what is needed and ensure that every piece of information is reflected in the problematization, students are informed that this effort is the first one they will begin but the last one they will complete. As this is the central piece of the research dossier, students are expected to link to information presented elsewhere in the *Newspaper*. Theoretically, a properly crafted op-ed should enable the instructor to read only this part of the *Newspaper* to capture the breadth and essence of the research.

Literature Review

To broaden the scope of their research problem, students collect articles and essays from serious newspapers, edited websites, magazines, and journals. They are encouraged to rely on digestible articles from sources such as the *The New York Times*, *The Economist*, and *The Atlantic,* rather than from overly technical scientific journals. The selected articles are shared by integrating salient excerpts (between 250 and 500 words + images if needed) in the Focus, Business, Art, and Science & Technology sections of the *Newspaper*. The selection of articles must pertain and be adapted to each of the sections of the *Newspaper*. Each section must be populated with a minimum of five articles.

The search for articles supports students in understanding the existing body of knowledge related to their project topic, making them aware of a broad range of issues and a wide array of ways to problematize the situation. To capture the breadth of perspectives, students must keep an open mind and feel entitled to consider as relevant articles that are directly or indirectly related to the research topic.

To support the capacity of the instructor to comprehend each student's reasoning, students are asked to include a short analytical comment at the end of each article excerpt. This comment serves to make explicit the relevance of the article to the main research topic.

Design Conjectures

Based on the literature reviewed, students develop four design conjectures, one for each topical section aside from the Number section. In the design world, a conjecture is a form of an early concept of the solution. It leverages sketching, creative thinking, and prototyping as generative research methodologies. These early concepts are based on partial information and are likely to be inadequate for various reasons. Nonetheless, they allow students to free their minds from the preliminary ideas they have inevitably forged (Darke, 1979). Engaging in this activity is also a strategy meant to prevent the later emergence of a fixation effect (Crilly, 2015).

Moreover, conjecturing has been demonstrated to be an effective generative research method (Yilmaz et al, 2016). Through conjecture, students can freely explore their problem space and uncover design-specific related issues (Wensveen & Matthews, 2015). In other words, design conjecture can point toward gaps yet to be investigated or opportunities for innovation that would otherwise have been difficult to uncover. Each conjecture must include a visualization, an evocative title, and a short descriptive and reflective narrative (around 250 words).

Expert Interview

To facilitate access to specialized knowledge in the short amount of time available to them, students conduct an interview with someone considered an expert on their research topic. Students must select an interviewee for his or her capacity to provide them with specific and precise insights into the topic. The interviewee can be a formal expert, such as someone with a strong foothold in an industry, a professor, a scientific expert, or an ad hoc expert, such as a long-time user. The aim of the interview is to gain access to insider knowledge. Through this interview students can also uncover matters of concern that they had not considered and validate these. Expert interviews are also a way to support students' critical mindset. The information offered by the experts enables students to consider how they are analyzing and interpreting information they are gathering elsewhere.

Students are free to include the interview in any section they see fit. However, the Focus section is the likely landing point, as the interview can efficiently complement the op-ed.

Survey and Data Visualization

To examine larger public practices, issues, or preferences, students design and disseminate a survey with 10 to 12 questions. The survey results alongside other key demographics from up to 10 secondary sources are presented as an infographic in the Number section.

Because surveys can now be easily disseminated through various social platforms, they allow students to reach a broad number of people with minimal effort. Although it is unreasonable to expect students to gather information robust enough to support any form of correlative analysis, surveys are an effective way to provide insights to work with

(Andres, 2012). They can broaden the spectrum of issues and perspectives, especially as students compare the results with their other analyses. In other words, even if partial and incomplete, the survey results feed into the portrait of the situation, and support a more nuanced analysis.

To support students in the dissemination of a useful survey, they are asked to provide the instructor with a copy of the questionnaire and a dissemination strategy plan that includes both where the survey will be published and a justification for the sampling strategy.

Learning Objectives

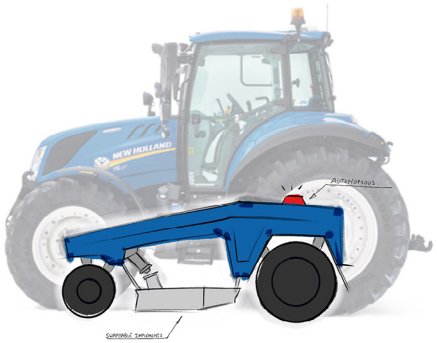
I designed this whole exercise as the main assignment for the DRIII course. In the scope of all course's assignments the *Newspaper* makes up 50% of the grade. Our program is set up such that this course spans over the course of seven weeks. Students meet in class twice a week for 5 hours and 40 minutes a session. Students are also expected to invest around 20 to 30 hours of time outside their class work. As the assignment spans five weeks, students spend around 150 hours completing the *Newspaper*.

As with any other assignment, the *Newspaper* is evaluated and graded. To succeed in this course, students must show not only advanced design research skills, but also autonomy. In a studio format, this course offers a large degree of flexibility. This is necessary considering that each student works on an individual topic. The way I designed the *Newspaper* was meant to allow students to pursue what they believe to be the best course of action without fear of failing. Although they are graded on the *product* (the *Newspaper*), the nature of the product allows my grading to account for the process and assess the skills demonstrated by the students. The assignment evaluation rubrics reflect these objectives (see Annex 1).

DISCUSSION: REFLECTING ON THE USE OF THE *NEWSPAPER*

As a pedagogical tool, the *Newspaper* was used in class with three cohorts of industrial design students (n=47). Every year the assignment see minor modifications to account for issues observed or reported through student teaching assessments or changes in the learning context. For instance, in 2020, due to the COVID-19 pandemic, the whole senior thesis course was carried out using a distance-learning mode of instruction. On that front, the *Newspaper* proved to be a formidable pedagogical asset supporting the development of asynchronous learning strategies, but that is a story for another time. Having experimented with the *Newspaper* over the t three years allows me to reflect on what this assignment provides in terms of pedagogical efficiency, especially with regard to the questions we previously stressed.

Small Automation Increases Access



Through designing this concept, I explored how driverless technology could decentralize labor in agriculture and decrease the scale of our designs of agricultural implements to make them accessible to more markets. I was inspired by the Fendt Xaver/MARS project and the Tilmor tractor.

Currently there is increasing consolidation of our farms. Some farms are growing bigger, while there is also a larger market for small, niche farms; meanwhile, we have all but lost medium-sized farms. One of the largest costs in agricultural production is labor. To reduce this cost, larger and larger implements have been designed to maximize the productivity of one person during their working hours.

The core benefit of the Fendt Xaver concept is its automation and scalability. Automation would eliminate the design constraint of human working hours. It would also eliminate the need for a laborer to physically sit in the tractor, allowing that work to run in the background and freeing the laborer to do other tasks. Scalability would allow access for all farm sizes, whether deployed in fleets of 3 or 50+. The benefits are accessible to all farm sizes, allowing designers and manufacturers to focus on the whole spectrum, rather than just the greatest concentration of wealth.

The core benefit of the Tilmor tractor is their passion for small to mid-size farms and the interchangeability of implements. This is necessary for sustainability and affordability as one engine can be used across a variety of tasks, similar to our current tractors, rather than automation that is designed solely for seeding as in the Fendt Xaver concept.

FIGURE 10. Example of student work using design conjecturing as a research method.

A Flexible Environment that Makes Sense for Students while being Manageable for Instructors

When I started developing this pedagogical tool, one aim was to support students' autonomy and their capacity to navigate the course in a way that makes sense for them. To support such a form of autonomy, we cannot predict that students will follow a specific process. Developing a garbage collection system based on the principles of the circular economy calls for a very different research design than finding a solution for chicken processing on small farms.

However, because of the numerous constraints previously noted, a certain level of oversight remains necessary. Students are not seasoned professionals with enough experience to know how to define the scope of a project based on the context of realization. Therefore, the assignment provides weekly milestones supporting its successful completion in the five-week timeframe allocated to it. Since this assignment seeks to encourage the development of the virtue of practical wisdom, students are encouraged to think of these milestones as fluid targets; the quality of the research remains the key criterion. Reflecting on the students' experiences over the past three years suggests that going back and forth between the different sections is the most productive approach. The difference in depth and quality between the information found in week 1 versus that found in week 5 is profound. Students' understanding of the issues at stake grows from narrow and naïve to systemic and complex incredibly quickly. Therefore, forcing them to tackle section after section denies them the opportunity to look for more far-reaching and challenging materials to complete the various sections. At the same time, because students populate the platform as they discover things, it remains easy for the instructor to follow their progress and support them.

Obviously, this fluid approach to deliverables can be a double-edged sword for students not accustomed to the responsibility of self-management. The workload associated with completing this assignment is significant and procrastination is likely to translate to failure. However, as project management is part of the list of learning objectives, it becomes an explicit matter of which students are made aware.

Over the past three years, the *Newspaper*'s conceptual architecture has shown a remarkable capacity to accommodate every project topic that was thrown at it. The flexibility offered by this assignment made all students capable of pursuing a particular research design and examining in-depth their project topic.[7]

[7] For those interested in comparing the capacity of the *Newspaper* to accommodate different research topics, students' *Newspapers* since 2019 are available at https://desis.osu.edu/seniorthesis.

Prototyping as a Research Method

The inclusion of design conjectures as a type of content is a way for students to engage in a design-specific research method. As suggested by Wensween and Matthews (2014), prototyping is considered as a means of inquiry. Prototyping can be an effective strategy as it can create a context for study. As design entails a transformation of the world, it is essential for early research endeavors to explore how transformation may occur and what it may entail (see Figure 4).

For the students who understood the principles and logic behind the design conjectures, the approach demonstrated efficacy. Design conjectures supported their understanding of their problem space by supporting their capacity to analyze information and account for matters at stake.

However, an interesting issue that we encountered during the first two years was that students delayed developing design conjectures until the very end. For them, this was a way to ensure the development of good ideas. Although this is understandable, as it allows for an interesting way to initiate the execution phase of the project, waiting to engage in the development of design conjectures prevented students from leveraging their creative and lateral thinking skills. In the third year, a *rule* was implemented to ensure that students made conjectures earlier. For that, a deadline was set for each one of the four conjectures. To alleviate students' anxiety about not being able to generate good conjectures, the evaluation rubric was reworded to emphasize that they would be graded on their ability to use ideation as a reflective research method.

Topical Division Supports the Development of Systemic Thinking

Although the *Newspaper* focuses on the curation and ordering of research findings and not directly on the expression of a problem statement (Dorst, 2015), the structure supports the development of a comprehensive diagnosis process (Proulx, Forthcoming). By having students populate the various sections of the *Newspaper,* they are mandated to look at their problem space from a number of different conceptual prisms. As students' research progressed, it was observed that their analysis of readings drew more and more links between their readings and fieldwork observations.

Interestingly, topical division has triggered two types of struggles regarding sorting and finding information. At the beginning of the process, students do not know what to look for in order to find relevant information to populate certain sections. The Business section has proved to be particularly difficult for many of them at first. They wonder how to explore this topic and draw connections to their design perspective on their project topic. Later in the process, a second type of struggle emerges as students start to see overlaps between the topical categorizations of

the *Newspaper*. These overlaps make them question where things belong.

> *[Student] For the Arts section, could Instagram/social media posts work because they are a form of self-expression? I was thinking of making one of my articles just a compilation of different things XXX have been posting.*
>
> *[Instructor] hmmm 🤔.*
>
> *[Student] I've been wanting to include some sort of "social listening" section somewhere in the newspaper but wasn't sure where would be best.*

This last struggle often led to discussions with the students about the framing and naming of the various sections. Although this could indicate some limitations of the tool, we interpret this as a sign of growth in the students' thinking and understanding of their project complexity. As they start grasping the complexity of their topics, the lines between categories blur, becoming more intricate and perhaps insufficient. Therefore, instead of seeing this as a limitation of the tool, we consider it a demonstration of its capacity to facilitate the development of nuanced and systemic ways of thinking.

All that being said, the possibility of adding more sections is an interesting avenue that will be worth exploring in the future. Given the relative ease of customization provided by the WordPress platform, it is possible to envision where topic sections could be renamed or new ones added.

The *Newspaper* as a Common Ground for Communication between Students and Instructors

As a pedagogical activity, this assignment is a great asset in supporting the instructor's capacity to accompany students through the sinuous journey that characterizes the research phase. Part of the instructor's role is obviously to oversee the work carried out by students and assess their progress toward the established learning outcomes. On that front, the *Newspaper* was, by design, developed to serve as a mediating tool. It allows for the non-intrusive oversight of students' work, something that is considered a significant challenge when all students work on different topics and progress along particular journeys. Because students populate the various sections of the *Newspaper* as they find information and conduct research, the platform facilitates communication between the students and the instructor. The platform is a common space that is accessible in real-time. As long as the instructor keeps up with the materials uploaded by the students, it is easy to engage with them and discuss their progress. The blog comment functionality of Wordpress is here proving handy. As an instructor, I can use the comments section to share notes and comments with the students.

As the outcomes of their research reside on the digital platform and not in out-of-reach personal notebooks or somewhere on their personal computer, it is easier to hold

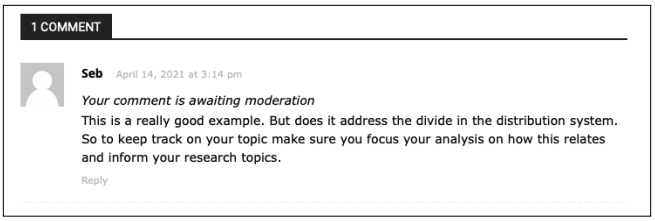


FIGURE 11. Example of a feedback comment made to a student post.

students accountable for their research findings. Formally, a rubric pertaining to the capacity to summarize research findings is included as a criterion of evaluation of the research review that follows the completion of the *Newspaper* assignment.

More importantly, having access to students' *Newspapers* has proven to be beneficial as they engage in the second phase of the capstone project: focusing on the development and execution of the project. As students funnel things down and start making design decisions, it is common for them to forget or overlook certain realities that were revealed during their research. As external critics and advisors with limited expertise on the project topics, instructors can also digress in the spur of the moment and lead students in directions that are not aligned with what students have observed and learned about their project topics. In that regard, the *Newspaper* is an empirically fed common ground that can form the basis of a constructive conversation about design decision-making.

The Impact of the *Newspaper* on the Final Capstone Project

Trying to illustrate the impact of the *Newspaper* on the final outcome of the capstone project is a difficult endeavor if we are to focus only on the final output of the project. For one, the variety of project type on which students engage on lead to various kinds of impact. However, one place where this assignment has shown effects is on the nature of the final presentation. It was observed through the students' final presentations that their discourse now has more depth and tends to focus less of the final outcome. Having gone through a structured and transparent research process and having an easy way to access their research findings, students can more easily convene key information explaining their thought process and support their design decision. As such, the focus of final presentations and the conversions they ensue, are more representative of the whole design process. To our great pleasure, discussions moved away fetishization of the outcome a significant shift bonded to me more constructive and supportive of the students learning experiences.

One other beneficial impact of the *Newspaper* is that it tends to act as an equalizer. Although good students, at ease with

conceptual thinking, could often do well in presenting their design process and the logic of their design decision, this assignment is proving supportive to students who do not share the same abilities. Again, by its form, the Newspaper allows students to circle back to their research and use it as a way to explicit how they connected the dots in their project.

As we continue to rely on this assignment and stabilize it form, it is planned to conduct a formal summative assessment of the tools. Through such assessment we seek to examine with more specificity, the effects and impacts the Newspaper has on the development of student capstone project.

CONCLUSION

Problematization is a central constituent of contemporary design practice; designers are no longer passively awaiting commissions (Muratowski, 2015). This means that educational programs need to introduce students to the principles and mechanisms supporting this type of analytical thinking. As design is a practical activity (Proulx, 2019), it is also important that designers are able to engage in such an intellectual process in an effective and pragmatic way. In the context of design, problematization is about understanding the intricacy of a situation in order to more soundly decide what to do, how to move forward in the design process. To support this kind of learning in the context of a capstone project, we here presented an assignment developed to help students engage in a comprehensive research endeavor without over-normalizing the processes. In a discipline such as design, as is typically the case in any area of the humanities, methodology follows the question. Therefore, if students are free to pose the question, then instruction strategies must allow for a flexible route. Because of time constraints and the cognitive resources that characterize the educational context, instructors cannot realistically develop and support individually tailor-made pedagogical strategies. Through this pedagogical strategy, we believe we have developed a model that allows students enough latitude to access information relevant and pertaining to their question, while also providing instructors with a model that allows them to remain on top of things and able to support their students.

Over the past three years, this assignment has been used thrice in industrial design, but also once in interior design and once in a multidisciplinary engineering capstone, with similar results each time. Overall, the results have been fairly positive, with students able to fulfill expectations quite successfully. One point that remains problematic is time management, as students do not fully understand that they have to begin working on everything at the same time and accept that the process is not to be conducted in a linear way. Although they are told that there is no right way to start and no need to research before engaging in conjecture development, for instance, they tend to wait until the end to develop better solutions. Although this is not fundamentally wrong, they need to understand that moving back and forth between different research strategies might be more productive in the end. As we continue to develop this assignment, our plan is to provide students with prompts to encourage them to engage in a more iterative process.

The next phase in assessing the efficacy of this pedagogical tool is to have it employed by other types of project-based disciplines (nursing, social work, policymaking). Thereby, we seek to establish whether its basic structure can support the research phase of different kind of capstone projects.

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