Research, Exploration, Demonstration
Capstone Proposals

The Scientific Method

While not all research and exploration needs to follow a strict scientific method, the core ideas can be a good starting point to think about various endeavors. We
– …observe something that we want to better understand.
– …undertake exploration to gain more context & information.
– …form a (null) hypothesis.
– …test the hypothesis by running an experiment and collecting data in the process.
– …determine whether we can make any scientific conclusions.
Exploration

The process of exploration itself takes many forms. Some things to keep in mind:

– We might need to learn more, related, topics to help construct a better context for our work.
– We should keep detailed notes with an eye towards being able to replicate things we do.
– In addition to trying variations (for example) to see what things work, we should consider trying things that we think will fail to make sure that they do.

Exploration Example

What if you wanted to explore pinhole photography but wanted to make use of modern digital tools?

• Could build a portable camera obscura and try to use your smartphone to capture the projected image.
  – Haven’t personally tried that yet…
• Could try to replace a digital camera’s lens with a pinhole.
  – [https://www.cs.umd.edu/~egolub/PinholeComparison/](https://www.cs.umd.edu/~egolub/PinholeComparison/)
Sympathetic Magic and Cargo Cults

We are perhaps all “guilty” of doing things in order to achieve a desired outcome because we saw others do them and achieve that outcome. The “cults” that were the aftermath of World War II might be the most well-known.

– Foreign troops air-dropped equipment and supplies in regions previously isolated from such things.
– Some of the indigenous people observed this and built mental models to explain them.
– When the troops left, the indigenous people built artificial air strips and mimicked the activities/appearance of the soldiers in an attempt to have the supplies return.

Know Your Tools

There are often a broad spectrum of tools that can be used in a field, and you are likely to have access to only a subset of those.

– Know what’s available to you to try out.
– Find out the costs of different tools across the spectrum.
– Learn about the trade-offs between different versions of tools (features, accuracy, durability, etc.)
– Once you have access to a tool, learn about it as much as you can, explore it, and try to think creatively on using it to accomplish your goals.
Example: Using a Flash

When using a flash when taking a photograph, there is more going on than just making the scene brighter.

– Sometimes the background is still dark but sometimes its brighter too.
– Sometimes the shadows are sharp, other times they are soft.
  • This reminds me a natural shadows on sunny and cloudy days.
– When I move the flash further away from the subject, the brightness gained drops faster than I expected.

Why do these things happen and how do I get more control over what happens?

Flash used in these examples…

• Under $100 dollars
• Fairly powerful (GN-140)
• Zoomable head
• Can be set to fire at full power, ½ power, ¼ power, 1/16th power

Photo from https://www.amazon.com/Vivitar-285HV-Flash-Cameras-Black/dp/B00004TVSP
Which photo do you think had the flash at the highest power setting?

Flash power: 1/16\textsuperscript{th} max

Flash power: 1/16\textsuperscript{th} max

Flash power: 1/16\textsuperscript{th} max
Which photo do you think had the flash the closest to Pikachu?

Flash power: 1/16\(^{th}\) max
Flash distance: 3 feet

Flash power: 1/16\(^{th}\) max
Flash distance: 6 feet

Flash power: 1/16\(^{th}\) max
Flash distance: 12 feet
With the flash power the same and the distance changing, how is Pikachu lit the same in all three?

Flash power: 1/16<sup>th</sup> max
Flash distance: 3 feet
Lens aperture: f/11
Shutter speed: 1/250<sup>th</sup>

Flash power: 1/16<sup>th</sup> max
Flash distance: 6 feet
Lens aperture: f/5.6
Shutter speed: 1/250<sup>th</sup>

Flash power: 1/16<sup>th</sup> max
Flash distance: 12 feet
Lens aperture: f/2.8
Shutter speed: 1/250<sup>th</sup>
Thoughts?

Have you formed any new questions or ideas or hypotheses based on the visuals and information presented?

Do you need to learn more about any of the terminology used on the previous slide to be better situated to form or refine these?

Some Hypotheses

- A light source that is further away, and thus is relatively smaller, will create sharper shadows.
- If I double the distance between the subject and the light source, I will need to quadruple the amount of light that I let into the camera to maintain the same exposure of the subject.
- The ratio of the distance between the light and the subject versus the light and the background will determine the background’s exposure.
Something to ponder…

These four were all taken within the same minute. What setting(s) do you think changed between shots?

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Many ways to design a project/proposal.

- Every proposal will have its own needs.
- These are general thoughts, which should help guide you in any specific field…
- An important set of goals is to have
  - a clear statement of an original/novel research idea
  - a solid rationale of why this should be done
  - support for why you are the person to do it
  - confidence that the project is not too large (if it is, you will want to rethink how you can break your big idea into several self-contained and worthwhile stages).
Capstone: Big Picture (overview)
You could think of a proposal as the start of creating a contract (either with yourself or an advisor or a funding agency) in which you specify things such as:
- Background information about your project’s domain.
- What you will do and how you will do it?
- Why it is something that is worth doing?
- What data you will collect, how you will collect the data, how you plan to process it and how you might plan to interpret it?
- What your timeline is going to be?

Capstone: Big Picture (details)
Background information about your project’s domain.
  • Prior work on which you will build will be there.
  • Sometimes known as the literature review.
What you will do and how you will do it?
  • Your research question will be there.
Why it is something that is worth doing?
  • This is sometimes called the need for research.
What data you will collect, how you will collect the data, how you plan to process it and how you might plan to interpret it?
  • Your methodology.
What your timeline is going to be?
  • How you will know that you are done?
Capstone: Literature Review (I)
Summarize *relevant* work that came before the project you are about to undertake…

– What existing work will you be extending?
– What mistakes of the past will you be avoiding?  (NOTE: Be careful how you word this since the people who *made* those mistakes might be reviewing your proposal.)

Capstone: Literature Review (II)
Establish that your work is unique.

– If there have been similar projects in the past, how is yours different?  (Your literature review can also reveal to you that your work would not be unique, in which case you need to work up a new project that is new!)
Capstone: Literature Review (III)

Note that the literature review helps you prepare but it is also going to serve as a way to demonstrate that you understand the problem while also providing confidence that you are well positioned to integrate your results into the existing pool of knowledge.

Why explore the past?

Before undertaking a new project, it is often important to perform a literature review and/or write a need for research statement in order to:

– Avoid doing something that’s already been done.
– Learn from the experiences of those who have already worked in the area.
– Look for gaps in existing work that you can help fill.
– Better define what you will be doing and why.
How broad and deep to search?

- There are times when you will want a very broad review of previous work in an area.
- There are times when you will want to dig down deep on a very narrow aspect of a domain.
- There are times when you want a little of both.
  - For your project proposals, you should try to explore both. Start with a broad search of your area of concern. Give a “big picture” overview of things. Then, select the works that are most related to yours and dig a little deeper.

Relating Previous Work to Your Project

Let’s say that you have found a paper by John Smith that talks about something related to your project. Don’t just say that Smith did XYZ.
- Yes, say what Smith did.
- Also, explain how Smith’s work directly or indirectly relates to your intended work.
- Say whether Smith’s work left something undone that your work looks to address.
  - Hint: If Smith’s work left something open and your project isn’t going to address it, you should be thinking about how your project could address it.
Learning from the work of others.
Aside from making sure what you want to do hasn’t already been done, reading what others have done can help you plan out your project.

– What methods and tools did others use that you can apply to your project?
– What techniques did others use to analyze and assess the quality or impact of their project that you could use?
– Did you see any paper-writing styles and structures that you felt were effective and could use as models?

Give attribution to the work of others.
If you make a statement such as “It has been shown that XYZ is true.” make sure that you cite your source for this claim.

Any time you refer to the work of others, users the words of others, or summarize the work and words of others, you need to *give them credit*!

Proper citations are about more than using the correct style guide. Proper citations includes making sure that you cite all resources used.
**Need for Research/Work (I)**

When you present what the research question / project is, it is often useful to say who will benefit from the result of your research and how.

- The goal of many projects is to add a missing piece to the existing body of knowledge in that area.
- Consider whether your work is generically for others to then use or if you have a specific application in mind.
- With the DCC capstone, we want you to do something that you find interesting but also look for it to connect in some way to the notion of Digital/Design, Cultures, and Creativity.

**Need for Research/Work (II)**

Related to this is the audience for your results.

- Who is interested in the existing body of knowledge?
- Why should they be interested in your results?
- You might consider where you intend to publish your results or present your creation as part of this.
- Do you want to educate others through your work?
- If there is a “hot” topic in the public eye to which your work can connect, it might be worth mentioning.

With the DCC capstone, your own curiosity and interests plays a large part, but these ideas should still be in your thoughts.
Ethical Considerations

There are (at least) two categories of ethical considerations.

– Human-subject participants and ethics. This isn’t likely to come up in this course, but it might. If you will involve people in your Capstone, please let me know so we can chat about this one…

– Ethics related to the results of your work and their applications. This can be a contentious topic, but I’d like it to be one we can discuss openly if needed.

Examples of Methodology

• Do you have a hypothesis/outcome/goal?
• Is your approach appropriate? Rigorous? Can you really implement it? How will you document your work?
• What are your independent variables? Dependent variables?
• Will it be quantitative or qualitative or mixed methods? Is that acceptable to your community?
• Will there be human-subject participants? How will you gather them?
• Are there instruments that you will be using? How will you gain access to them? Calibrate them?
Demonstrating your Results

At the end of your capstone semester, you will present your work in various forms.
- The final “product” of your capstone.
- A write-up describing your work and results.
- The “Capstone Fair” presentations.

Consider the spectrum of your audience for each item, and how best to communicate your results in a way that will help them understand and appreciate your work.

Tip: Identifying Benchmarks

“So, how does it end?”
- Does the project have a natural beginning and middle and end?
- Does an exploratory or pilot stage make sense? Is the project itself an exploratory or pilot stage for a larger one?
- Should the project be divided into stages where each stage can be identified and indicate progress?
- If benchmarks are not reached, do you have a plan to adapt/adjust the project to respond to whatever stood in the way of that benchmark?