Proposal to create a special major in

COMPUTING, DESIGN, AND PEDAGOGY

By Izzy Lapidus, Barnard College, Class of 2024

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Proposed Major Title: Computing, Design, and Pedagogy (CD&P)

No Established Departmental Major Rationale: Explain why you cannot satisfy your goals/interests within an established departmental major.

Originally, I planned on being a Computer Science major with a minor in Education. I began to struggle with the idea of majoring in computer science because I realized that I want to pursue coursework that was more interdisciplinary and allowed me to more thoroughly explore my questions regarding the relationship between computing and pedagogy. Within the established Computer Science major, I found that there were several required courses where my interests beyond solely computer science could not be satisfied. Within the established Education minor, my specific interests in the pedagogy of computer science can not be explored to the extent that I wish to pursue them. I have many questions and curiosities concerning computer science pedagogy, and wish to pursue them in a way that no established programming offers. My interest in design is both the factor that was missing most from any established department at Barnard, and the concept that ties together my interests in computing and pedagogy best. Design is an interdisciplinary field of study, and plays a paramount role in both my intellectual curiosities in computing and pedagogy. There is no design major or concentration offered at Barnard. On neither the Computer Science major side or the Education minor side did I find a way of studying the intersection between each of these disciplines with design in any institutionalized way. On the computing side, I'm particularly interested in questioning how we design applications and websites that prioritize user needs, wants, and concerns so that we can build technology that is useful, beneficial, and impactful for its users. A focus on design is central to the majority of the computer science classes I have listed on my proposed course of study, differing from the typical Computer Science major course load. On the pedagogy side, I'm fascinated by questioning the design of the ideal computer science learning environment so that every student is able to learn in the way that suits their individual needs, wants, and concerns best. This is why several of the courses I have listed on my proposed course of study are in the Psychology department, which goes beyond the span of the Education minor. Where computing, design, and pedagogy ultimately intersect the most when we question how we can build educational technology that teaches and supports students as they explore computation. By bringing design into the conversation, it can be seen how thinking about users and students as analogous to one another is core to my passions and creates coherence among my proposed course of study. In conclusion, there is simply no established departmental major that currently encapsulates the breadth of my interests and their interdependence on one another; thus, the approval of a specialized major is imperative to pursuing my intellectual curiosities.

Major Rationale: Develop a preliminary rationale for the proposed major: Why is this major important to you?

This major is a synthesis of my three core interests: computing, design, and pedagogy. I'm fascinated by each of these disciplines alone, and even more so when combined together. I've had an interdisciplinary set of interests for as long as I can remember, which is why this major has been constructed in such an interdisciplinary manner. I've always been drawn to programs and experiences that enable me to combine my various interests, and that is exactly what I've elected to do through my proposed course study in Computing, Design, and Pedagogy (CD&P).

Much of my major is inspired by an undergraduate program offered at USC in the Iovine and Young Academy. As participants in this program, students receive a Bachelor of Science in Arts, Technology, and the Business of Innovation. Students engage in a four-year course of study that centers around four core areas of learning: the arts and design, engineering and computer science, business and venture management, and communication. I was drawn to this program mainly because of its interdisciplinary academic track that brings STEM into dialogue with other fields, and have opted to create a major at Barnard that likewise lets me explore a STEM discipline, specifically computer science, in an interdisciplinary and design-infused fashion. Unlike USC's program, my proposed course of study focuses deeply on pedagogy, as this is the discipline I'm most interested in bringing into dialogue with STEM.

Although Barnard offers several interdisciplinary programs such as ICORE (Interdisciplinary Concentration on Race and Ethnicity) and MORE (Minor on Race and Ethnicity), no such established interdisciplinary programs exist for students interested in exploring computer science and a non STEM discipline, such as education. One can apply a programming and/or problem-solving skill set to any field of study, and programmers are needed in every single industry. This illustrates how interdisciplinary computer science is becoming, although this was not always the case and is not necessarily reflected in many established computer science departments and curricula. Through my major courses, I strived to develop a new blueprint for pursuing a computer science education in an interdisciplinary manner. I am passionate about exploring how best to teach computing and design computer science learning tools and environments that are interdisciplinary, pertaining to the nature of the subject. Additionally, there is an implicit feminist agenda embedded in my major. Exploring the intersection of computing and pedagogy is particularly significant at an institution founded on the education of women, particularly in male-dominated fields. As a Barnard student and young woman myself, it is ever more important to me that computer science learning spaces and the tech community at large are supportive and inclusive environments for women, non-binary individuals, and people of color. There is a lack of proper access to computer science education, specifically in K-12 education, in this country, and I believe that it is imperative that every student—especially those of diverse backgrounds and identities—who shows interest in learning how to code can gain this skill set through tools and learning environments that meet their needs. My major centers around exploring this topic, and I am hopeful that through my proposed course of study I can obtain answers concerning my many questions about the future of computer science education.

A paramount feature of my major is its emphasis on design. The Strate school of design tells us that design is "the process of envisioning and planning the creation of objects, interactive systems, buildings, vehicles, etc. It is all about creating solutions for people, physical items, or more abstract systems to address a need or a problem." I've opted to craft a major based around design so that I can gain the skill sets that will help me make the world a better place through technology. Examples of this include, improving the experience of learning how to code across different age levels, experience, and abilities; understanding the role of computational thinking; and bringing a design mentality to coding-based projects in order to teach students the skills needed to solve today's most pressing problems. In all aspects of my major, design is present. It was an intentional decision that I opted to title my major Computing, Design, & Pedagogy, with design in the middle. I use design in my major to bring together computing and pedagogy, and that's why the word design belongs in the middle of these two disciplines. Additionally, I like to think of my major as *centered* in design. All of the computing classes that I am including in my major have a focus in design, and the leading reason I'm electing to study pedagogy is so that I can interrogate the design of ideal (computer science) learning environments. I'm enthralled by the notion of design, and hope to become proficient in it through my proposed course of study.

As of now there is no established academic program or department that is able to support my specific interests. Ironically, it was precisely Barnard's focus on interdisciplinarity—particularly in the innovative Milstein Centers—that drew me to the college. I'm very involved with the Athena Center for Leadership, the Vagelos Computational Science Center, and the Center for Engaged Pedagogy. Additionally, I look forward to taking advantage of the Design Center, Digital Humanities Center, and the Slote Media Center in my next few years at Barnard. I've been using these centers to explore my interdisciplinary interests, and am currently working on a project in collaboration with the Center for Engaged Pedagogy titled The Future of Computing at Barnard, or shorthand FC@BC. Through this project, I am asking the research question "How do the experiences of Barnard students in computing classes inform the future of computing at Barnard and beyond?" Through the crafting and administering of a survey, I'll be gaining insight on the experiences of current Barnard students in Barnard and Columbia computing classes. Data from this survey will be analyzed and curated into a selection of holistic recommendations for the future of Barnard Computer Science, all based around the wants and needs of students. As evidenced by this project, I'm passionate about engaging in research projects that enable me to tackle my many questions concerning the relationship between computing and pedagogy, which is why many of the courses I've opted to include on my course list have a hands-on, project component.

As much as I've loved my outside-the-classroom research projects, I really want to be taking full advantage of the incredible courses offered at Barnard and Columbia. Although there is no established program that quite satisfies my interests, there are numerous individual classes that, when put together, enable me to pursue my passions. I've spent months researching all of the computing, design, and pedagogy courses I could find on the Columbia Course Directory and beyond. I'm excited by the coursework that I've put together and am confident that I will have

the most valuable, inspiring, and authentically Izzy Lapidus undergraduate academic experience should my special major be approved.

Beyond the coursework itself, creating this major is important to me because forging my own path is just who I am. I come from a long line of changemakers and people who did whatever they could to pursue their dreams. My mom, my biggest inspiration, attended Cornell where she created her own major, and then went onto pursue law school at Harvard before leading the Women's Rights Project at the ACLU for 18 years. My mom passed away when I was 16 years old, but if there is one thing she taught me it is to advocate for myself. She also taught me that I can do anything if I try hard enough, so I am committed to getting this major approved. I have thought extensively about every course on this list, worked hard to form connections with faculty, and built a special major that will provide me with the most rewarding educational experience possible.

Table Containing Proposed List of Major Courses

This table is in alphabetical order, by department. Within departments, courses are ordered numerically. Each course is bookmarked to its description and rationale. If viewing this proposal on a device, click each course title for easy access. This table includes my senior project (course no. 11).

	Dept. and Course no.	Points	Course Title	Term
1.	COMS W1004	3	*Intro-Comput Sci/Prog In Java*	Spring 2021
2.	COMS W3134	3	*Data Structures in Java*	Spring 2022
3.	COMS BC3162	3	*Developing Accessible User Interfaces*	Spring 2022
4.	COMS W4170	3	*User Interface Design*	Fall 2022
5.	COMS W4460	3	*Prin-Innovatn/Entrepreneu*	Fall 2023
6.	COMS E6998	3	*Adv Web Design Studio*	Fall 2023
7.	EDUC BC1510	4	*Educational Foundations*	Fall 2021
8.	EDUC BC3042	4	*Gender, Sexuality, and School*	Spring 2023
9.	EDUC BC3050	4	*Critical Pedagogies*	Spring 2022
10.	EDUC BC3052	4	*Math & The City*	Spring 2023
11.	EDUC BC3152	0	*Math & The City Fieldwork*	Spring 2023
12.	EDUC BC3799	TBD	*Independent Study - Senior Project: CS & The City*	Fall 2023, Spring 2024

13.	IEME E4200	3	*Human-Centered Design & I*	Spring 2022
14.	INAF U6126	3	*Design for Social Innovation*	Spring 2024
15.	PSYC BC2106	1.5	*Psych of Learning - Lab*	Fall 2022
16.	PSYC BC2107	3	*Psych of Learning - Lec*	Fall 2022
17.	PSYC BC3195	4	*Seminar in Educational Psychology: Human*	Fall 2022

Course Description and Rationale (Including Senior Project)
This list is in expected term enrollment order. It is structured in this way to indicate how classes build upon one another to create a rigorous proposed course of study.

1. ***Intro-Comput Sci/Prog In Java*** - Completed
    a. Description: A general introduction to computer science for science and engineering students interested in majoring in computer science or engineering. Covers fundamental concepts of computer science, algorithmic problem-solving capabilities, and introductory Java programming skills. Assumes no prior programming background.

    b. Rationale: Through the completion of this course, I developed a foundation in algorithmic design, thinking, and problem-solving. I finished the course with an essential understanding of how to program in Java and gained experience in computing.

2. ***Educational Foundations*** - In Progress
    a. Description: Introduction to the psychological, philosophical, sociological, and historical foundations of education as a way to understand what education is, how education has become what it is, and to envision what education should be.

    b. Rationale: This course has presented me with a foundational understanding of education in America. This course has been essential in establishing a groundwork in thinking about and critiquing education, skill sets I have begun and will continue to put to use in my specified areas of pedagogical interest, such as in math and computer science learning environments.

3. ***Data Structures in Java***
    a. Description: Data types and structures: arrays, stacks, singly and doubly linked lists, queues, trees, sets, and graphs. Programming techniques for processing such structures: sorting and searching, hashing, garbage collection. Storage management. Rudiments of the analysis of algorithms. Taught in Java.

    b. Rationale: This course will enable me to further develop my computational skills in Java. Having a background in data structures and algorithms is fundamental to speaking the language of computer science. This course will ensure my

understanding and expertise in essential technical knowledge.

4. ***Critical Pedagogies***
    a. Description: This course explores education as a process through which critical consciousness and epistemic justice combat oppression in communities. Students will connect seminal work by critical pedagogues, such as Paulo Freire and bell hooks, to systemic educational challenges and lived experience. As a class, we will investigate power dynamics and structural inequalities at the systemic, institutional, interpersonal and individual levels. Students will problem-pose, dialogue and create pedagogical tools through praxis, by integrating the theory learned in the class to educational practice.

    b. Rationale: This course will enable me to develop a deeper understanding of pedagogy by learning from the great thinkers in the education space, such as Paulo Freire and bell hooks, and help me apply their teachings to contemporary computational settings.

5. ***Human-Centered Design & Innovation***
    a. Description: Harry West wants his students to design a better world. In the Human-Centered Design class that he teaches at Columbia, West encourages students to approach problems with an open mind and no preconceptions. “In human-centered design, we don’t suppose the answers, and that’s the whole point,” says West, Professor of Practice in Mechanical Engineering. “When we are building a new product, service or system, the real experts are the end users—the consumers, customers, citizens or employees—and we get to better solutions by talking to them, observing them and discerning their needs, wants and aspirations. Then, through an iterative process of ideation, prototyping and testing we converge on designs that really resonate with the people we are designing for and meet their needs. In my class I teach how to talk to regular folks and listen out for what is important to them, with the ultimate goal of creating better experiences for them, and hopefully, a better world.”

    b. Rationale: This course will enable me to gain first-hand experience in designing with specific people in mind. When it comes to developing both new technologies and developing different pedagogical approaches to education, this class will ensure that I have experience in putting the needs of the people I am designing for first. It will act as a great way to synthesize my interests in computing and pedagogy.

6. ***User Interface Design***
    a. Description: Introduction to the theory and practice of computer user interface design, emphasizing the software design of graphical user interfaces. Topics include basic interaction devices and techniques, human factors, interaction styles, dialogue design, and software infrastructure. Design and programming projects are required.

b. Rationale: This course will enable me to further develop my skill sets in computational thinking and design. Through this course, I will dive deeper into thinking about how humans interact with technology. I will leave this course with more experience and projects that center at the intersection of computing and design.

7. Seminar In Educational Psychology: Human

a. Description: This seminar provides an introduction and overview of key contemporary research and professional issues in the field of Educational Psychology. Educational psychology can help students develop well-informed, empirically sound, creative, and ethical judgments about educational goals, policies, and practices. This course examines the theoretical and applied aspects of learning, motivation, human development, assessment and evaluation in the educational setting. Content includes the study of learning theories as well as cognitive, emotional, and social learning theories that underlie education and human development. Emphasis is placed on developing skills to better understand learners to foster improved learning, influence and manage classroom learning, and recognize and consider individual differences.

b. Rationale: This course will enable me to obtain a conceptuational understanding of education through a psychological context, and will enable me to develop deeper theories concerning the different ways and methods through which humans learn. I will be able to apply what I've learned in this course to thinking about the pedagogy of computation, and how different individual factors affect the ways that students learn.

8. Psych of Learning - Lec

a. Description: Lecture course covering the basic methods, results, and theory in the study of how experience affects behavior. The roles of early exposure, habitation, sensitization, conditioning, imitation, and memory in the acquisition and performance of behavior are studied.

b. Rationale: This course will enable me to achieve a practical understanding of education through a psychological context with the addition of a hands-on lab component.

9. Psych of Learning - Lab

a. Description: Corequisites: PSYC BC2107 Psychology of Learning Lecture. Students conduct experiments analyzing learning and memory in rats and humans.

b. Rationale: This course is the lab component of the course previously listed above and will directly enable me to apply the new knowledge I've learned about the psychology of learning through hands-on experience. Conducting experiments will enable me to put my classroom learning directly into practice.

10. Design for Social Innovation

a. Description: Design for Social Innovation is a project-based initiative and course where Columbia University students work in teams to solve real-world problems on behalf of social sector clients including nonprofits, social enterprises, and government agencies. Design For Social Innovation (DFSI) is a semester-long course where Columbia University students and faculty support social enterprises, nonprofit organizations, and the public sector to address complex, ambiguous global problems through human centered design. The course is open to students from Columbia's 20 undergraduate and graduate schools via an application and interview process. The 3.0 credit course is a collaboration between the Columbia Entrepreneurship Design Studio and the Columbia School of International and Public Affairs (SIPA).

b. Rationale: This course will enable me to gain experience working with established enterprises and organizations. As a course I will take later in my time at Barnard, it will be a great way for me to apply skill sets I've gained in design thinking throughout my previous courses, and will be a great opportunity for me to work with real-life clients.

11. Developing Accessible User Interfaces

a. Description: Introduction to access technology and the development of accessible systems. In this course, students build and evaluate various access technologies. Topics include: text-to-speech, speech recognition, screen readers, screen magnification, alternative input, tactile displays, and web transformation. This course teaches students the deep inner workings of today's user interface technology and serve as a guide for building the user interfaces of the future.

b. Rationale: This course will enable me to further develop my computing skill sets, particularly through the programming language JavaScript. It will also allow me to explore a particular interest I have in accessible design and how that relates to computational thinking. Through this course, I will develop projects that will give me hands-on experience at the intersection of computing and design.

12. Gender, Sexuality, and School

a. Description: Broadly, this course explores the relationship between gender, sexuality, and schooling across national contexts. We begin by considering theoretical perspectives, exploring the ways in which gender and sexuality have been studied and understood in the interdisciplinary field of education. Next, we consider the ways in which the subjective experience of gender and sexuality in schools is often overlooked or inadequately theorized. Exploring the ways that race, class, citizenship, religion and other categories of identity intersect with gender and sexuality, we give primacy to the contention that subjectivity is historically complex, and does not adhere to the analytically distinct identity categories we might try to impose on it.

b. Rationale: This course will specifically enable me to interrogate the feminist lens and agenda of my major by giving me the proper background in the relationship

between gender and sexuality and school. This course will help me understand the historical and social context of intersectional inequities in schooling, with a particular focus on gender and sexuality.

13. Math & The City

a. Description: In partnership with NYC public school teachers, students will have opportunities to engage in mathematical learning, lesson study, curriculum development, and implementation, with a focus on using the City as a resource. Students will explore implications for working with diverse populations. Non-math majors, pre-service elementary students and first-year students welcome. Fieldwork and field trips required.

b. Rationale: This course will enable me to gain hands-on experience in NYC math classrooms. Through this course, I will explore some of my biggest pedagogical questions concerning math education and will develop a strong skill set as both a student and researcher. This course will also allow me to work closely with one of my major advisors, Professor Rivera, and will be helpful in providing the background of my senior project and independent study with Professor Rivera.

14. Math & The City Fieldwork

a. Description: N/A

b. Rationale: This course is the fieldwork component of the previously listed course, Math & The City. Participating in fieldwork is core to my interests in developing hands-on experience to better understand the design of math classrooms. This fieldwork lab will serve as an application of the material I will be learning in seminar.

15. Adv Web Design Studio

a. Description: 1. Master front-end and back-end technologies for making interactive websites. 2. Discover specific user needs by developing a low-level, mechanical model of human behavior. 3. Practice iterative design to meet specific user needs.

b. Rationale: This course will serve as an upper-level course at the intersection of computing and design. It will enable me to apply computing skill sets I've developed throughout my previous computing classes to create advanced projects. It will also allow me to put my studies in designing with specific users in mind to use.

16. Prin-Innovatn/Entrepreneu

a. Description: Team project centered course focused on principles of planning, creating, and growing a technology venture. Topics include: identifying and analyzing opportunities created by technology paradigm shifts, designing innovative products, protecting intellectual property, engineering innovative business models.

b. Rationale: This course will serve as a direct application of skill sets I will have developed all throughout my time at Barnard, enabling me to bring together my interests in computation and design to create a startup prototype.

17. Independent Study - Senior Project: CS & The City

a. Description: This course will function as my year-long senior essay project that I will conduct under the guidance of one of my major advisors, Professor Rivera. Professor Rivera and I have already discussed this project, and it will be further developed when I participate in her Math & The City course at Barnard during Spring 2023. This course will be similar to Math & The City in that it will function in collaboration with NYC public school teachers and I will have the opportunity to engage in computational learning, pedagogical study, experiential design, curriculum development, and implementation, using the City as a resource. I will facilitate the research component of this project during Fall 2023 of my senior year and complete the writing component of this project during Spring 2024 of my senior year.

b. Rationale: This is my senior project. It provides an appropriate culmination of my major in that it will enable me to explore the intersection of computing, design, and pedagogy. Design will be used as a methodology for exploring the relationship between computing and pedagogy. I will bring together skill sets I have been taught throughout my time in computing, design, and pedagogy classes at Barnard to develop innovative computing curriculums geared towards engaging students that may otherwise not feel encouraged to explore computation. All work I do will be done in collaboration and partnership with NYC public schools and teachers, and will ultimately be centered around creating the best possible learning environments for students.

Major Advisors Rationale

I've elected to have two major advisors, one in Barnard's Computer Science program and one in Barnard's Education Department. These are the two programs/departments at Barnard that housing my major in makes the most sense given my proposed list of courses and research interests. It is important to me that my major and I have a home in each of these programs/departments. After meeting with Professor Sarah Morrison-Smith of Barnard Computer Science and Professor Maria Rivera Maulucci of Barnard Education, I have determined that both will be an excellent fit to guide me in my major studies. Both professors were eager to work with me and take me on as their advisee and I am grateful for their support.

Statements of Support

I. **Major Advisor: Professor Morrison-Smith, Computer Science**
II. **Major Advisor and Essay Sponsor: Professor Rivera, Education**
III. **Program Director: Professor Wright, Computer Science**

IV. Department Chair: Professor Abu El-Haj, Education

Closing Statement

Thank you very much for reading my proposal to create a specialized major in Computing, Design, and Pedagogy. I look forward to hearing your feedback and working together to bring this major to life.

Sincerely,