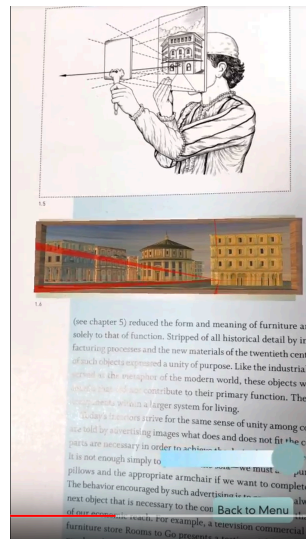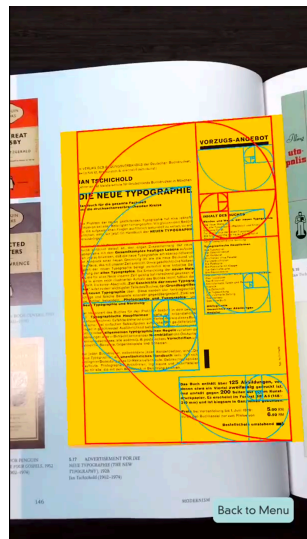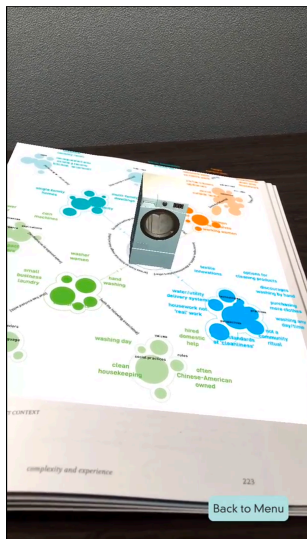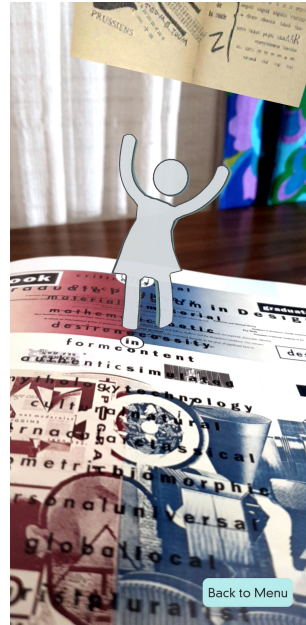## EVIDENCE OF OUTCOME

Images of the project
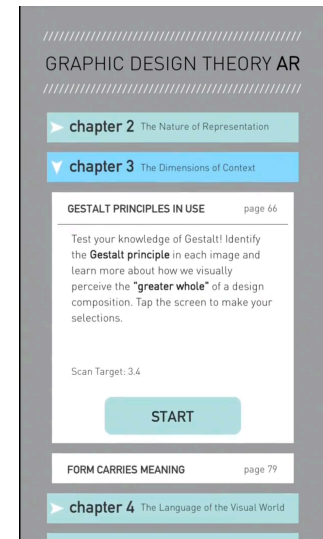
Above: screen shots of lessons included in the GD303 AR app. **Top row (left to right):** 3D columns pop out of the textbook to show Jefferson's use of Roman capitals communicating the ideals of the new Republic; Frenetic typography enacts the dynamism of Marinetti's Futurist Manifesto; a virtual guide explains McCoy's use of Structuralist theory in the design of her Cranbrook poster; a magnifying glass helps users read the tiny details of Emigre magazine. **Bottom row (left to right)**: an animated concept map; Jan Tschichold's invisible grid is revealed; principles of linear perspective are demonstrated inside the painting; interface design and navigation system for the GD303 AR app.

Links to the project

In addition to the still images on the previous page, there are two options for viewing the augmented
reality content in action:
Option 1: watch pre-recorded videos of individual experiences
OR
Option 2: download to your smart phone or tablet and use the Target Images PDF to trigger live experiences

Option 1 Instructions (with links 1–13):
note: some videos are repeated loops — you do not need to watch the full length of these videos
1. video of the Menu Options & Interface Design (Introduction, Getting Started & Helpful AR Tips sections)
2. video of Chapter 1 AR experience "Renaissance Perspective"
3. video of Chapter 2 AR experience "Invisible Image Vectors"
4. video of Chapter 3 AR experience "Gestalt Principles in Use"
5. video of Chapter 3 AR experience "Form Carries Meaning"
6. video of Chapter 4 AR experience "Langue and Parole" (audio on!)
7. video of Chapter 4 AR experience "Seeing Text and Reading Images" (audio on!)
8. video of Chapter 5 AR experience "Capturing Motion"
9. video of Chapter 5 AR experience "Modernism's Grids"
10. video of Chapter 6 AR experience "Helvetica's Un-style"
11. video of Chapter 6 AR experience "Emigré Magazine Typographic Structure"
12. video of Chapter 7 AR experience "Design is Situated"
13. video of Chapter 7 AR experience "Brand Experience Design"

Option 2 Instructions
1. *for **Android***: go to Google Play https://play.google.com/store/apps/details?id=edu.ncsu.delta.graphicdesigntheory
    *for **Apple iOS***: go to the Apple Store and search this term: 'Graphic Design Theory AR NC State University'
2. install and then launch the app (note: some experiences include sound; please make sure your device's audio is on)
3. open the GD303 Supplemental PDF on a computer
4. from the AR mobile app on your device, choose the first experience under Chapter 1 Menu "Renaissance Perspective"
5. point your device at the computer monitor displaying the Chapter 1 target image in the PDF
6. hit the 'Start' button
7. you can find general instructions in the main menu under "Getting Started"

User testing
We tested the user experience and interface design at DELTA through a survey (N = 11). The survey comprised six questions
that measured ease of use, navigation, understandability and engagement. Participants had a range of familiarity with using
Augmented Reality. On a scale of 1 to 5 (with 5 being highest level of familiarity) participants were: Very Unfamiliar = 1;
Somewhat Familiar = 4; Familiar = 4; and Very Familiar = 2. All participants selected "Agree" or "Strongly Agree" for questions
related to usability and engagement (i.e., nobody selected "Disagree" or "Strongly Disagree"):

1. The menu for the AR was intuitive and easy to navigate (Strongly Agree = 10; Agree = 1)
2. Overall, the AR App increases engagement with the textbook (Strongly Agree = 7; Agree = 4)
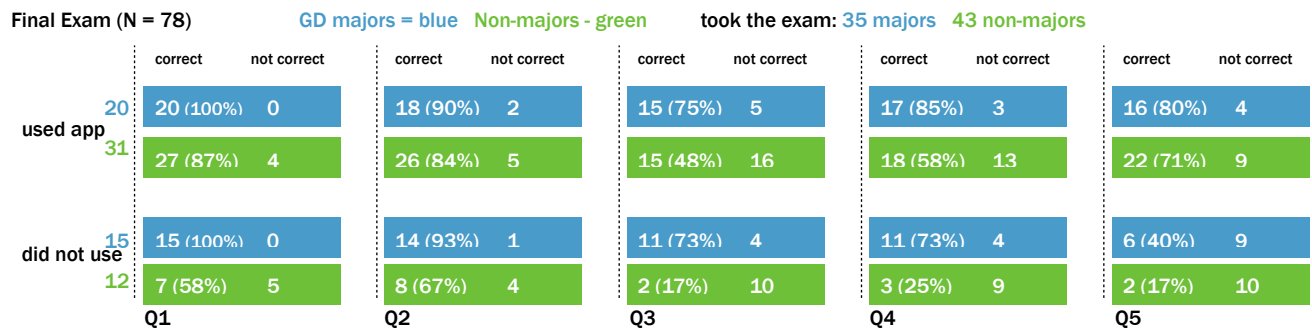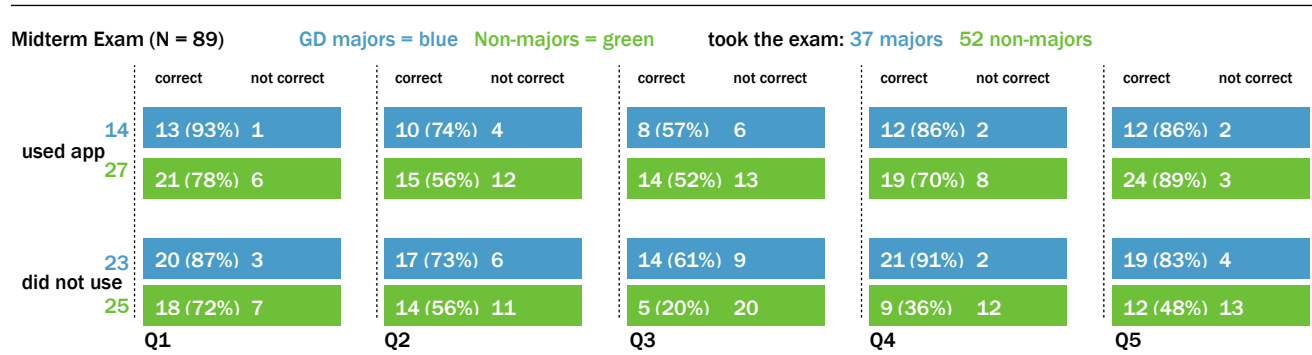
3. The AR app is fun and exciting (Strongly Agree = 6; Agree = 5)

Question 7 solicited qualitative feedback and suggestions; a sample is found below:

1. I Liked the quiz, it is something students can do while reading the book. Also liked the image rotation & magnifying glass. To me, it takes reading textbook from passive reading to active and interactive learning.
2. I really loved the ones with sound and it's neat if it shows "bonus' content or info that I can't get from the book.
3. A cliche - but really brought it to life. Cool to be able to do that within the book instead of googling.
4. If there's activities or exercises that relate to what I saw in the AR app, that also helps me feel like it's worthwhile and engage more with the AR portion. I think my desire to use it and its effectiveness is if it shows me info I can't get just by reading the book. Otherwise, I'd likely lose motivation to use it. I want to feel like I'm learning something extra or being let in on a secret - that makes it exciting. Also sound is super fun, perhaps warn me in case I'm studying in the library.

## Exam scores improved for GD303 students who used the AR app

Five (5) exam questions related to core concepts covered in the app were included on each exam. Students who used the app to study were more likely to get these questions correct compared to students who did not.

Midterm Exam (N = 89)   GD majors = blue   Non-majors = green   took the exam: 37 majors   52 non-majors

		Q1 correct	Q1 not correct	Q2 correct	Q2 not correct	Q3 correct	Q3 not correct	Q4 correct	Q4 not correct	Q5 correct	Q5 not correct
used app	14 (blue)	13 (93%)	1	10 (74%)	4	8 (57%)	6	12 (86%)	2	12 (86%)	2
	27 (green)	21 (78%)	6	15 (56%)	12	14 (52%)	13	19 (70%)	8	24 (89%)	3
did not use	23 (blue)	20 (87%)	3	17 (73%)	6	14 (61%)	9	21 (91%)	2	19 (83%)	4
	25 (green)	18 (72%)	7	14 (56%)	11	5 (20%)	20	9 (36%)	12	12 (48%)	13

Final Exam (N = 78)   GD majors = blue   Non-majors - green   took the exam: 35 majors   43 non-majors

		Q1 correct	Q1 not correct	Q2 correct	Q2 not correct	Q3 correct	Q3 not correct	Q4 correct	Q4 not correct	Q5 correct	Q5 not correct
used app	20 (blue)	20 (100%)	0	18 (90%)	2	15 (75%)	5	17 (85%)	3	16 (80%)	4
	31 (green)	27 (87%)	4	26 (84%)	5	15 (48%)	16	18 (58%)	13	22 (71%)	9
did not use	15 (blue)	15 (100%)	0	14 (93%)	1	11 (73%)	4	11 (73%)	4	6 (40%)	9
	12 (green)	7 (58%)	5	8 (67%)	4	2 (17%)	10	3 (25%)	9	2 (17%)	10

Exam Question Examples

Several students drew diagrams as answers on exam questions that were related to core concepts explored in the app. These students' drawings clearly imitate what they remembered the AR experiences "looking like." A few examples follow below.

- -

Example 1: 3-point perspective
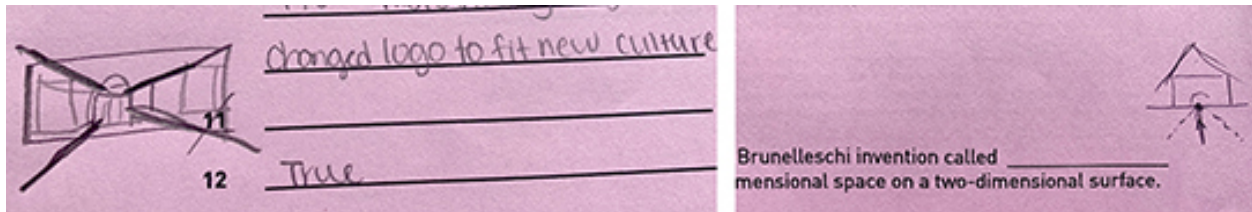
Above (left and right): The two images show a diagram by two different students who self-reported using the AR app, as sketched on their paper-based exam for the question:


The 16th-century Renaissance architect Filippo Brunelleschi's invention called _____ , was a new visual code for representing three-dimensional space on a two-dimensional surface (Answer = three-point perspective).

The students clearly recalled what this term "<u>looked like</u>" from the AR experience (bottom image in Figure 3).

Left: Screen shot showing the experience of the three-point perspective lesson within the AR application.

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Example 2: Implied Image Vectors
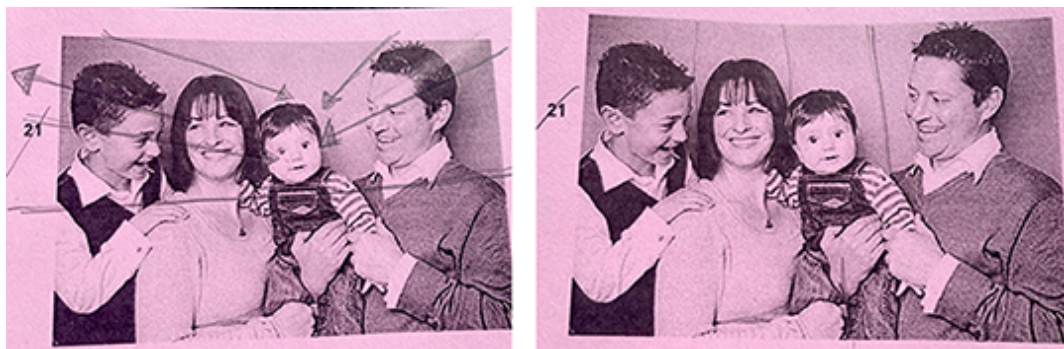
Above: Question 21 asked: "**Draw the vectors on the photograph.**" The image above on the left is a diagram by a student who reported using the AR app, a correct response. The diagram on the right, an incorrect response, represents the typical sketch by students who reported not using the app.

Left: Screen shot of the AR experience showing the live "Invisible Image Vectors" lesson as it appears live in the application.

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Example 3: Seeing Text & Reading Images
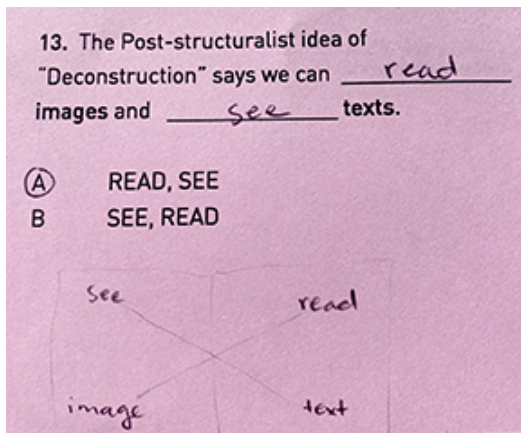
Above (left): Exam Question 13 covers a Post-structuralist theory that states readers of texts not only "see", but "read" images; and they not only "read," but "see" text.

Above (right): Screen shot of the AR experience for the "Seeing Text and Reading Images" lesson as it appears live in the mobile app. The diagrammatic AR content is highlighted in the orange overlay.

A student's answer to Question 13 (above left), for which she drew a diagram from memory of what she saw in the AR experience. The similarity in the student's diagram to the actual AR experience can be compared in the two images.