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Measuring student mastery of sustainability competencies

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Measuring student mastery of sustainability competencies

Vanessa Levesque, PhD

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University of New Hampshire

Association for Environmental Studies and Sciences

June 2018

Context: New Sustainability Dual Major at UNH



Sustainability competencies

“Complexes of knowledge, skills, and attitudes that enable successful task performance and problem solving with respect to real-world sustainability problems” (Wiek et al 2011)

Sustainability competencies

“Complexes of knowledge, skills, and attitudes that enable successful task performance and problem solving with respect to real-world sustainability problems” (Wiek et al 2011)

Competence	Description
Systems	Ability to analyze complex systems across multiple domains or scales.
Futures (or Temporal)	Ability to connect past and future societies & environments and develop potential scenarios.
Values (or Ethical)	Ability to identify and assess ethical issues, and to apply concepts of justice and fairness.
Interpersonal	Ability to understand, communicate and collaborate across diverse individuals and organizations.
Strategic	Ability to understand transitions and apply innovative strategies for transformation.

Assessing mastery of sustainability competencies

No agreed upon method

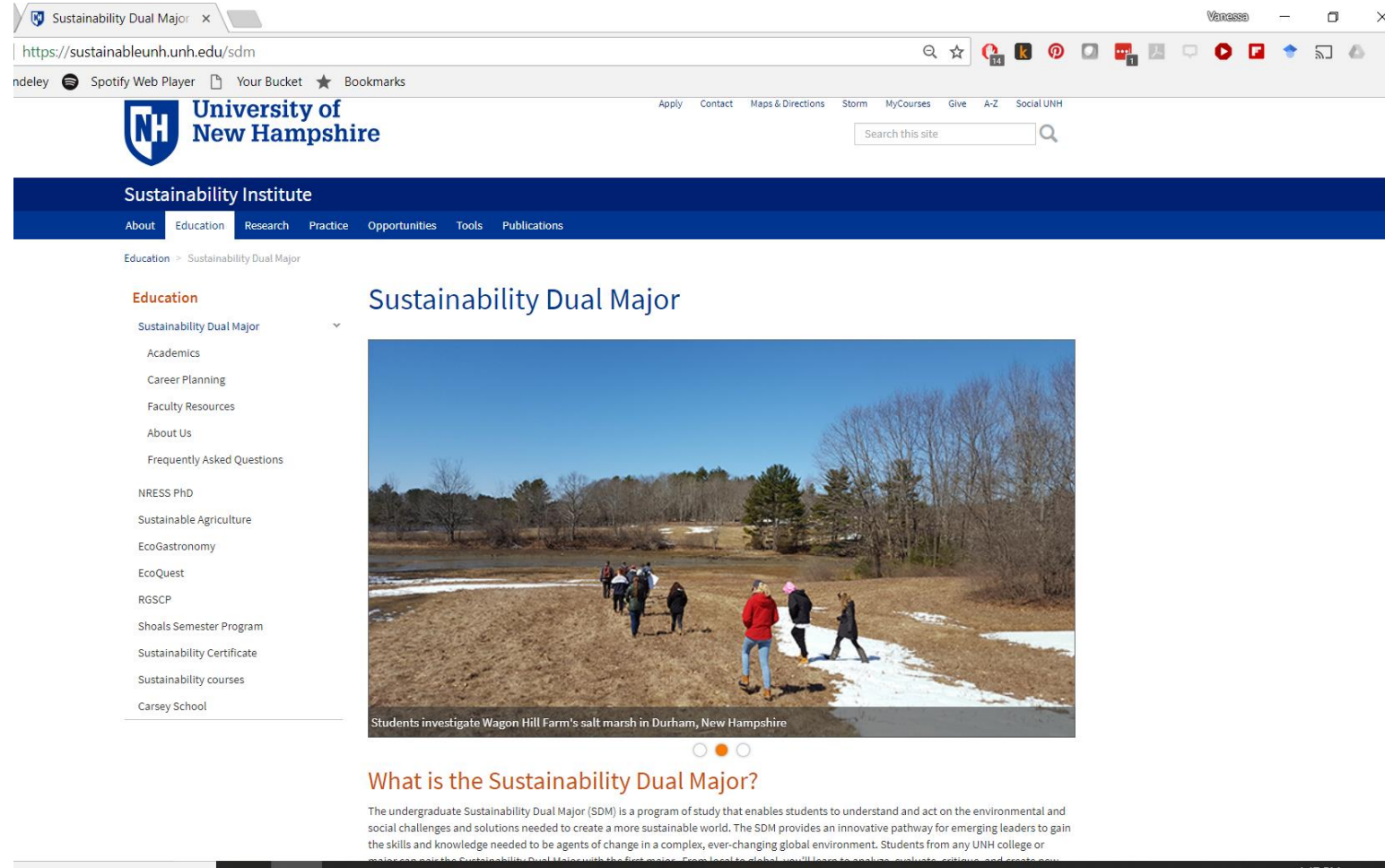
- Course evaluation comments (Brundiers and Wiek 2017)
- Student self-assessments (Galt et al. 2013)
- Responses to questions about written case studies (Remington-Doucette 2013)
- Multiple choice knowledge-based test (Zwickle et al. 2014)

Research questions

1. To what extent do students graduating with a sustainability dual major demonstrate sustainability competencies?
2. How does participation in an immersive case-study capstone advance student competency?
3. What can we learn from different methods of measuring competencies?

Sustainability Dual Major (SDM)

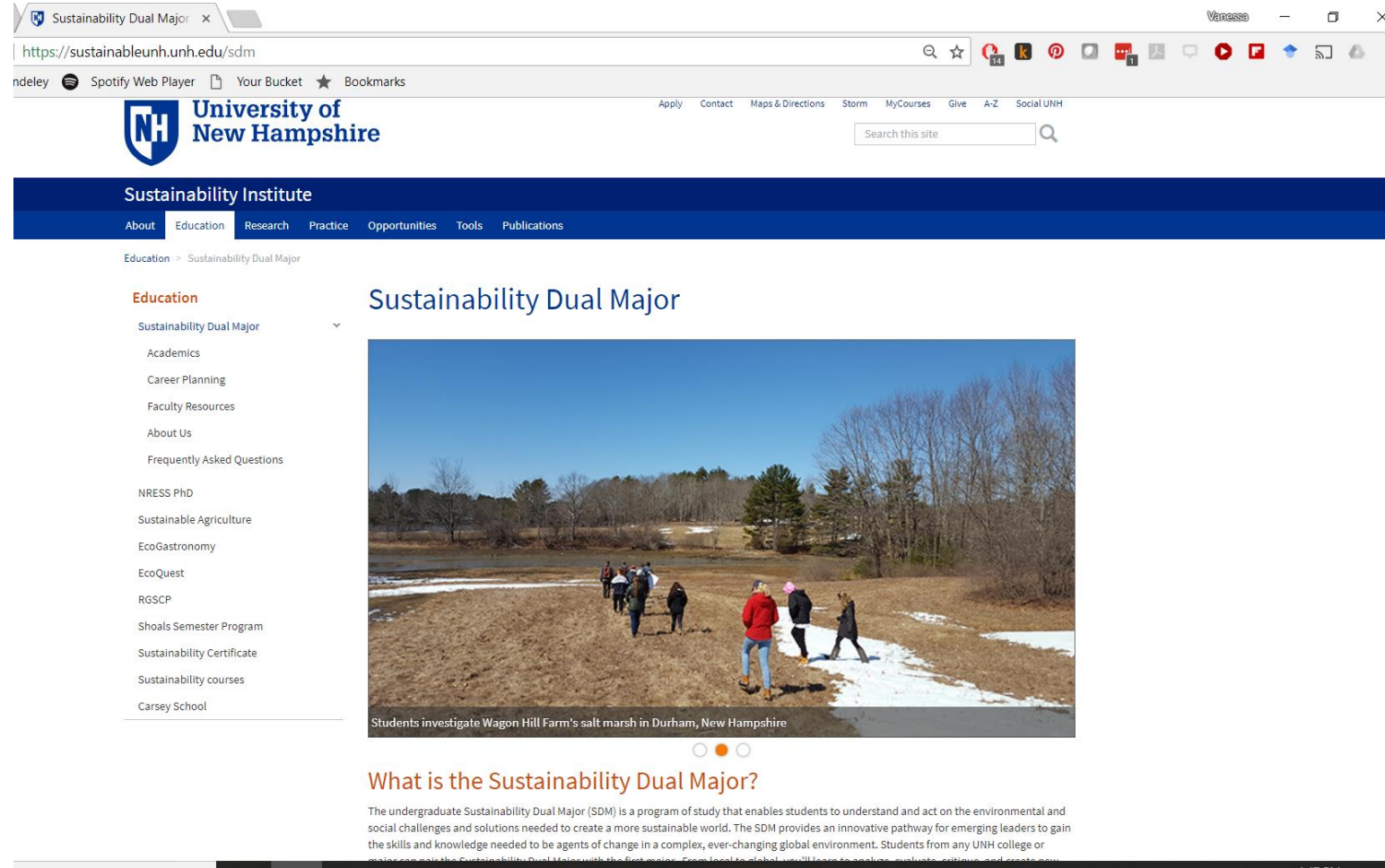
- Must be paired with primary major
- 3 core courses
 - Introduction
 - Methods
 - Capstone
- 5 pre-approved electives from across the university



The screenshot shows a web browser window displaying the University of New Hampshire Sustainability Institute website. The URL is <https://sustainableunh.unh.edu/sdm>. The page features the University of New Hampshire logo and a navigation menu with options: About, Education, Research, Practice, Opportunities, Tools, and Publications. The 'Education' section is expanded, showing a list of links including Sustainability Dual Major, Academics, Career Planning, Faculty Resources, About Us, Frequently Asked Questions, NRESS PhD, Sustainable Agriculture, EcoGastronomy, EcoQuest, RGSCP, Shoals Semester Program, Sustainability Certificate, Sustainability courses, and Carsey School. The main content area is titled 'Sustainability Dual Major' and includes a photograph of students in a field. Below the photo is a caption: 'Students investigate Wagon Hill Farm's salt marsh in Durham, New Hampshire'. A section titled 'What is the Sustainability Dual Major?' follows, with a paragraph of introductory text.

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Sustainability Dual Major

Students investigate Wagon Hill Farm's salt marsh in Durham, New Hampshire

What is the Sustainability Dual Major?

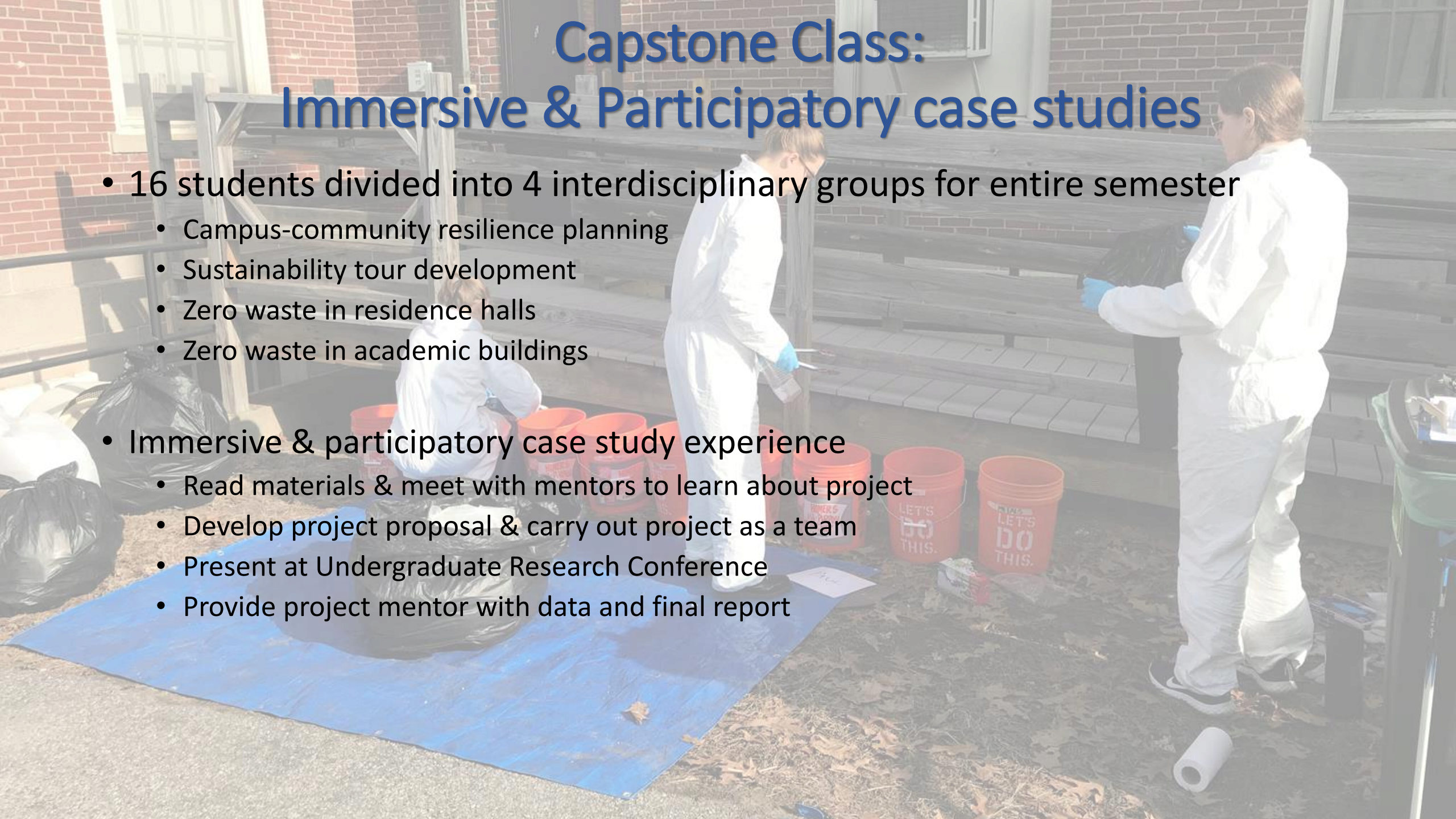
The undergraduate Sustainability Dual Major (SDM) is a program of study that enables students to understand and act on the environmental and social challenges and solutions needed to create a more sustainable world. The SDM provides an innovative pathway for emerging leaders to gain the skills and knowledge needed to be agents of change in a complex, ever-changing global environment. Students from any UNH college or

Capstone Class: Immersive & Participatory case studies



Capstone Class: Immersive & Participatory case studies

- 16 students divided into 4 interdisciplinary groups for entire semester
 - Campus-community resilience planning
 - Sustainability tour development
 - Zero waste in residence halls
 - Zero waste in academic buildings
- Immersive & participatory case study experience
 - Read materials & meet with mentors to learn about project
 - Develop project proposal & carry out project as a team
 - Present at Undergraduate Research Conference
 - Provide project mentor with data and final report



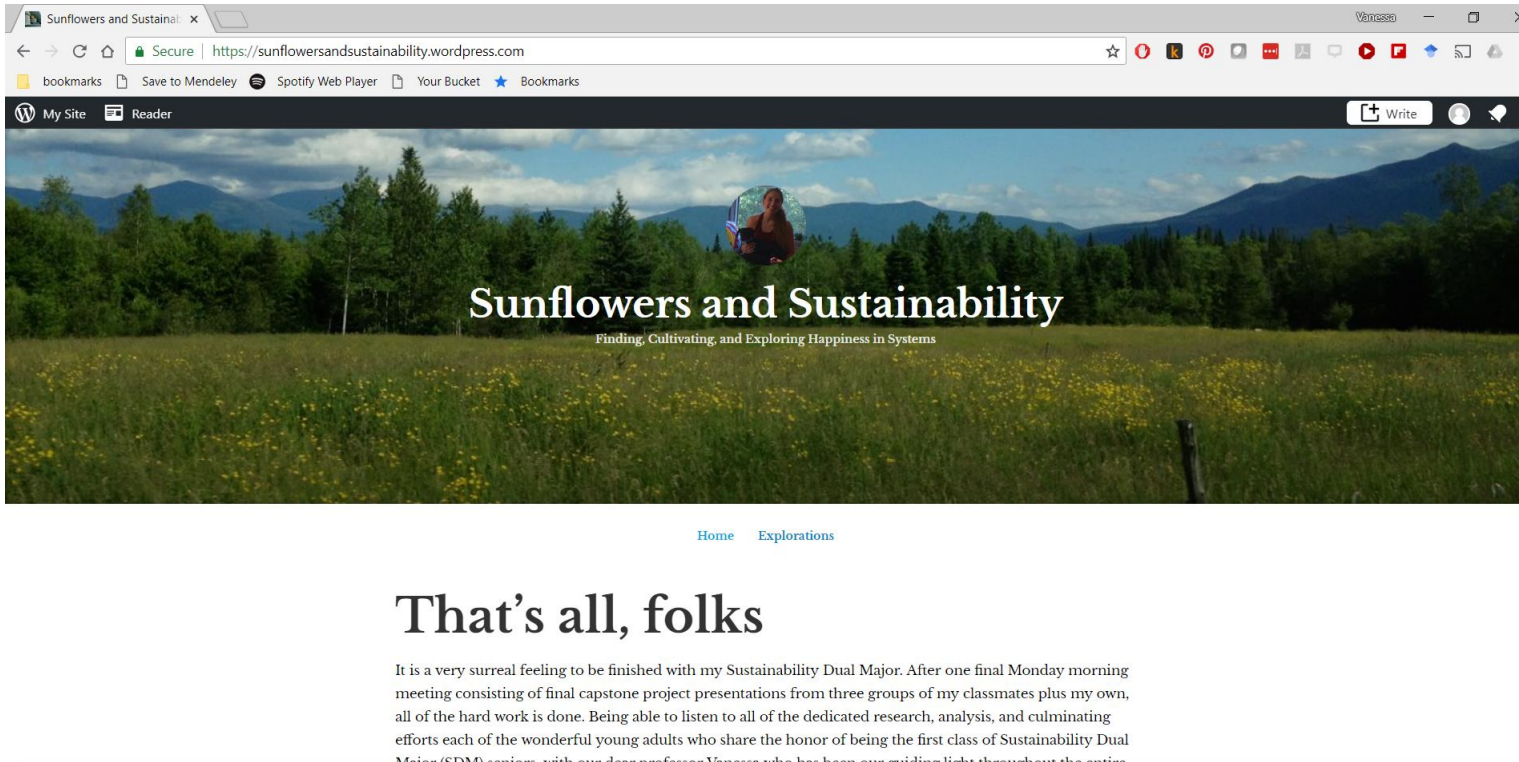
Methods: Quantitative survey & Qualitative analysis of blog posts

Survey

- Developed by Redman & Wiek, ASU, being tested in US & Germany
- Multiple choice questions for 4 of the 5 competencies we were interested in: Systems, Strategic, Values, Futures (*+ Problem solving; - Interpersonal*)
- 16 Capstone students given survey at start and end of semester

Methods: Quantitative survey & Qualitative analysis of blog posts

Blogs



The screenshot shows a web browser window displaying a WordPress blog. The browser's address bar shows the URL <https://sunflowersandsustainability.wordpress.com>. The page features a large header image of a sunflower field with mountains in the background. A circular profile picture of a woman is overlaid on the image. The site title "Sunflowers and Sustainability" is centered, with the tagline "Finding, Cultivating, and Exploring Happiness in Systems" below it. A navigation menu includes "Home" and "Explorations". The main content area displays the title "That's all, folks" in a large, bold font, followed by a paragraph of text.

My Site Reader Write

Sunflowers and Sustainability

Finding, Cultivating, and Exploring Happiness in Systems

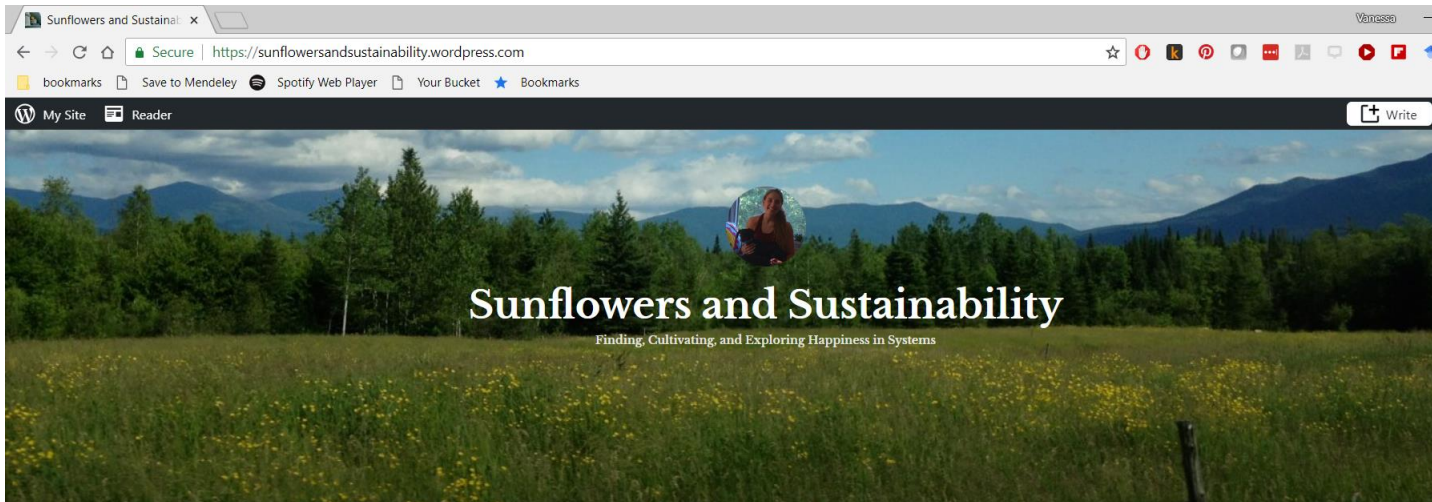
[Home](#) [Explorations](#)

That's all, folks

It is a very surreal feeling to be finished with my Sustainability Dual Major. After one final Monday morning meeting consisting of final capstone project presentations from three groups of my classmates plus my own, all of the hard work is done. Being able to listen to all of the dedicated research, analysis, and culminating efforts each of the wonderful young adults who share the honor of being the first class of Sustainability Dual Major (SDM) seniors, with our dear professor Vanessa who has been our guiding light throughout the entire

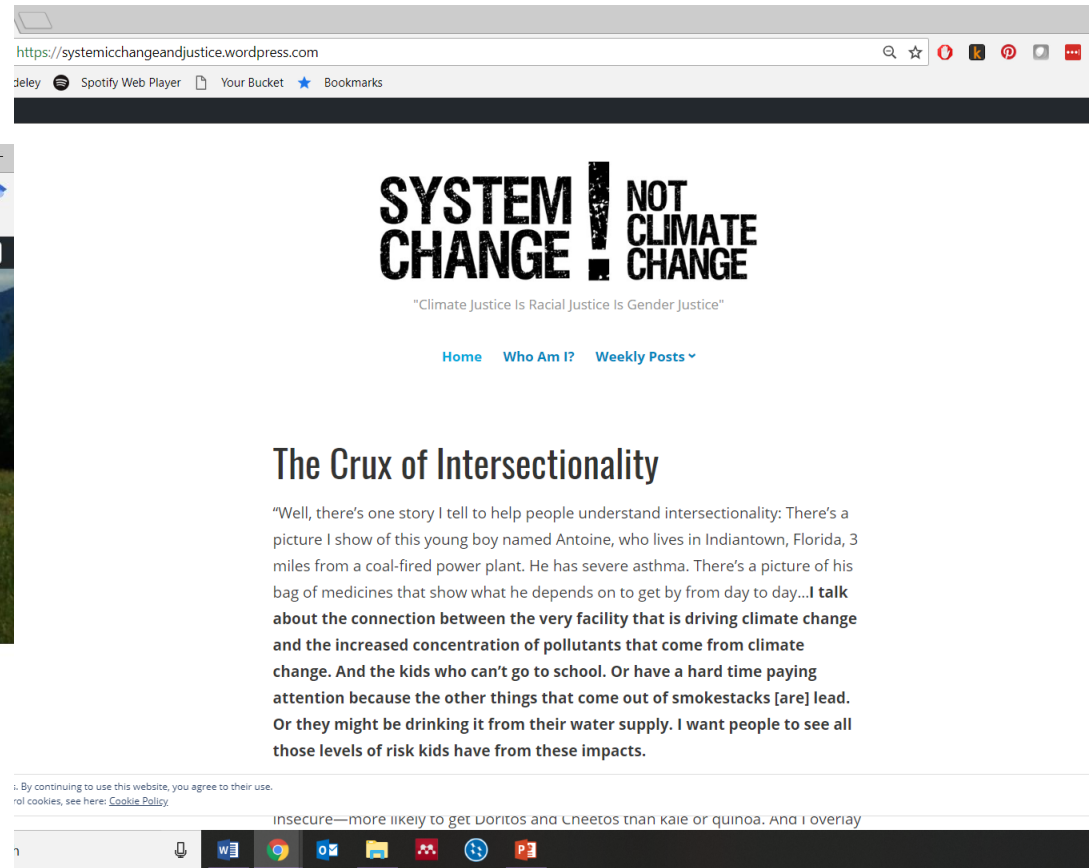
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Methods: Quantitative survey & Qualitative analysis of blog posts

Blogs

The image displays three overlapping browser screenshots related to sustainability and climate change blogs.

- Top-left screenshot:** Shows the homepage of "Sunflowers and Sustainability" (https://sunflowersandsustainability.wordpress.com). The header features a photograph of a sunflower field with the text "Sunflo" partially visible.
- Top-right screenshot:** Shows a browser window with a banner that reads "SYSTEM CHANGE! NOT CLIMATE CHANGE". Below the banner, there is a navigation menu with "Who Am I?" and "Weekly Posts".
- Bottom screenshot:** Shows a blog post titled "Reflecting on Electives..." by Kevin Dobson's blog, dated March 20, 2018. The post header includes a photograph of wind turbines and a sunset over a field. The main text of the post begins: "One of the more recent electives I have taken which I found interesting was a course titled Economics of Climate Change. I took the course because an older student who was in the sustainability dual major program recommended it. Being a course that uses some economic concepts, I would only recommend it to dual majors who are comfortable with economics. While being challenging at times, it was rewarding to examine climate change from the perspective of economists."

Methods: Quantitative survey & Qualitative analysis of blog posts

Blogs

- We identified all mentions of the 5 competencies and scored each one based on the degree to which the student demonstrates mastery

Competence
Systems
Futures
Values
Interpersonal
Strategic

Score	Description
0	No mention of competency concepts
1	Mentions term/concept with no explanation
2	Implies concept in an example
3	Describes & applies concepts to an example

Example: Systems thinking, level 1

“Through taking Economics of Climate Change, I gained an understanding of just how linked the economy and environment are.”

Example: Systems thinking, level 2

“...Both corn and soy beans are able to be stored pretty much indefinitely, which makes them good options for providing food to third world countries and to people affected by natural disasters. I think these programs are well intentioned but have some serious consequences that were not intended. For example, providing food to third world countries can actually put their local farmers out of business.”

Example: Systems thinking, level 3

“...Locals wanted Wagon Hill Farm to be open to all types of recreation, including dog-walking, but there was also a push to conserve the land, as erosion was a problem. These recreational activities directly contributed towards erosion, but to fully condemn them would be very unpopular locally. In sustainability, a major theme deals with balancing human activities with conservation efforts.”

Results

Survey

Competency	Avg % correct (Start)	Avg % correct (End)	Rank (Start)	Rank (End)
Systems Thinking	61.5%	56.8%	4	4
Futures Thinking	42.8%	49.3%	5	5
Values Thinking	70.6%	69.2%	2	1
Strategic Thinking	71.2%	63.6%	1	2
Problem-Solving	68.7%	62.0%	3	3

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Blogs

Competency	Avg score (max =3)	Rank
Systems Thinking	2.4	2
Futures Thinking	0.7	5
Values Thinking	1.6	4
Strategic Thinking	1.5	3
Interpersonal	2.6	1

Discussion

Q1: To what extent do students graduating with a sustainability dual major demonstrate sustainability competencies?

- It depends on how you test them!
- This suggests that competency assessments that rely on one method may not be as valid

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Interpersonal	2.6	1

Q2: How does participation in an immersive case-study capstone advance student competency?

- Multiple-choice survey suggests no change
- But blog posts suggest otherwise...

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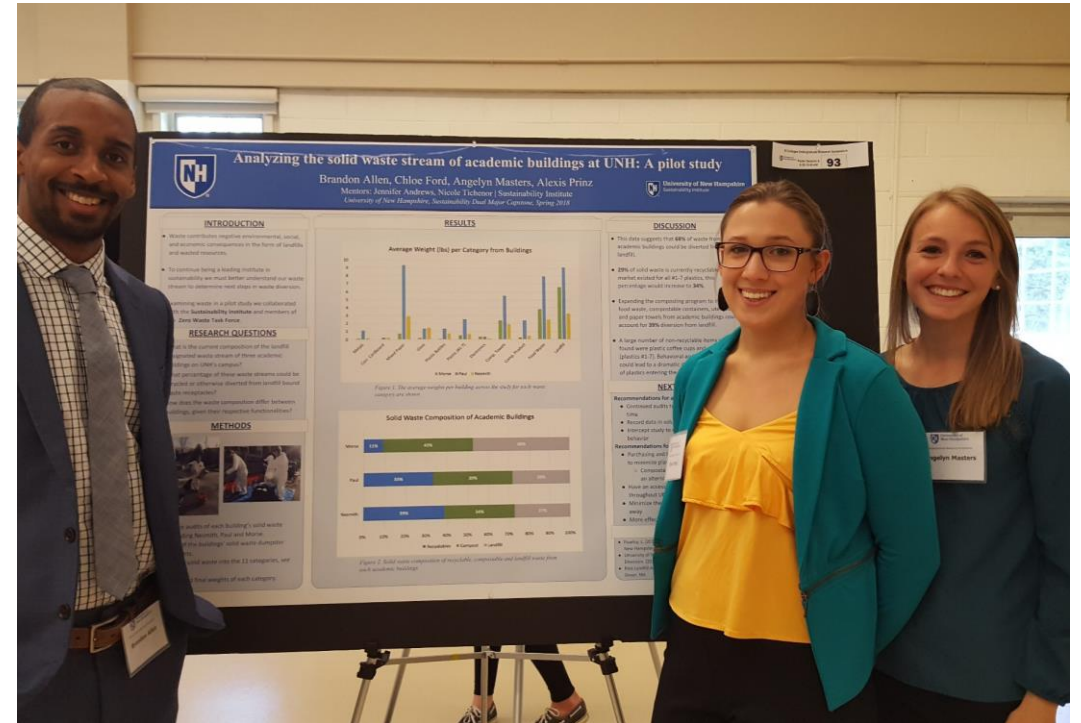
I have never worked on a group project with **people from all different majors**...Our project creating a Sustainability Tour of UNH excels because of the contribution of knowledge from so many areas.

This project helped me to truly understand and appreciate the **collaborative processes** that happen when tackling matters of sustainability... I learned **first hand just how important interpersonal, organizational, and various other skills are** in these projects.

Q3: What can we learn from different methods of measuring competencies?

Neither surveys nor open-ended blog posts seemed to fully assess mastery of competencies

- Survey questions rely on knowledge of specific terminology and concepts
- Blogs limited by extent to which students can express themselves in writing
- Open-ended questions were not designed to map onto the competencies
- Yet open-ended questions allowed other possible competencies to emerge



Discussion


Suggested new competencies:

1. Basic knowledge of grand challenges (e.g. climate change, water quality & quantity, food systems, waste, etc.)

Discussion

Suggested new competencies:

1. Basic knowledge of grand challenges (e.g. climate change, water quality & quantity, food systems, waste, etc.)
2. “Sustainability in Practice” – high level understanding of how the concepts within each competency play out in real projects



I personally learn more from direct application...
Understanding sustainability is more than a concept, it's
an experience and I believe sustainability students will
become more passionate about sustainability if they
have more opportunities to do so.

Discussion

Finally, are certain pedagogical approaches better suited to teaching certain competencies?

- Blog posts scored high on interpersonal competence: Did the immersive case study experience help develop those collaborative skills?

Thank you! Questions?

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