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SUSTAINABILITY STEW: A RECIPE FOR PROBLEM FRAMING AND DISCUSSION

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ABSTRACT: The concepts and practices surrounding sustainability are increasingly the focus of many new post-secondary and graduate education programs. However, the term *sustainability* refers to a complex mixture of disciplines, methods, contexts, and topics. This complexity is often confusing and can create barriers to learning. Comprehensive understanding of sustainability issues requires that students engage in an active learning process, focusing on context and perspective. Our "Sustainability Stew" curriculum, designed by doctoral students in various fields related to sustainability, is intended to guide sustainability education while offering the freedom to explore complex issues in an active, project-based learning environment. In this paper, we provide background and details for the design of the Sustainability Stew Guide and report results from student surveys on the curriculum itself from one undergraduate sociology course at the University of Alaska Fairbanks (n=37), one community college course at Delaware Technical and Community College (n=11), and one graduate-level research group at the University of Delaware (n=7). Student survey results and instructor reports suggest that the Sustainability Stew curriculum is an effective and innovative approach to sustainability education. Finally, we offer analysis and future directions for similar post-secondary sustainability education. Our objective is to offer a novel exercise to aid educators in teaching and discussing the concepts of sustainability in a way that encourages critical, multi-disciplinary engagement.

KEYWORDS: Sustainability, curriculum, problem framing, discussion guide, multi-disciplinary, ontology, ecology, post-secondary education

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1. INTRODUCTION

Sustainability is often a confusing concept with numerous and ever-changing definitions applied in a multitude of subject areas, all attempting to contextualize the word and make it useful (Lele 1996). Definitions of sustainability have been discussed for nearly three decades as researchers operationalize the term for scientific contexts. Resistance to narrowing down a definition has been common (Norgaard 1996), as contradictions in the various pathways to definition reflect the power held by "definers" therefore illuminating their inherent worldviews and value judgments. The social and political processes that give definitions specific context can often dominate the communication and learning process (Pappas 2012). In short, the term *sustainability* has been widely used, yet it is poorly understood and seldom discussed in light of larger theoretical bodies of work.

While conceptual confusion is part of the inevitable course that any term will chart as it becomes common in discourse, it is important to think of a concept like sustainability as the result of social and political processes (Herremans & Reid 2002). As the constraints of its definition change, so do the ways in which we can understand how to operationalize definitions to make them meaningful for both research and teaching. This is especially important for post-secondary instructors, who may recognize the importance of addressing sustainability in courses, but may be hindered by the lack of conceptual clarity (Colucci-Gray et al. 2006, Minguet et al. 2011, Pappas 2012). The Association for Advancement of Sustainability Higher Education (AASHE) defines sustainability in an inclusive way, encompassing human and ecological health, social justice, secure livelihoods, and a better world for all generations (2012). AASHE also notes that higher education plays a vital role in ensuring that people have an understanding of the interdependencies between environmental, social, and economic forces and the skills and abilities to meet sustainability challenges (AASHE 2012). The multifaceted nature of the concept of sustainability makes it challenging to address in post-secondary curricula while simultaneously providing opportunities for novel teaching and learning strategies.

Post-secondary sustainability education is frequently conceptual in nature because traditional styles of teaching do not fit well with the multiple goals and topics of sustainability, which can easily become overwhelming if students are not given the critical thinking tools to address them (Burns 2011). For complex topics like sustainability, the learning process needs to employ not definition and fact-based means to an end, but innovative and active solutions, such as problem and project-based learning at the individual level (Sriskandarajah et al. 2010). These experiential education methods can provide a dynamic and creative space for teaching and learning in ways that traditional processes cannot. This type of education requires students to learn in order to then make decisions, collaborate, and create solutions (Chambers 2009). More importantly, students learn new ways of knowing as community context and equity issues are highlighted through the experiential education processes (Cress 2004). These transformative processes maximize potential for learning and growth for students through rich interactions with instructors and curricula that focus on the importance of feedback and dynamic relationships in the classroom (Krasny et al. 2009, Slavich & Zimbardo 2012).

To re-examine the concept of sustainability as existing in constant conversation with teaching and learning methods, it is helpful to move past definition debates and create meaningful learning experiences for a generation that will face extremely complex and high-stakes issues. The Sustainability Stew Guide is the result of a breakout session at the second Conference for Sustainability IGERTs in Tempe, Arizona in October, 2009. Conference attendees were doctoral student fellows in National Science Foundation-funded IGERT (Integrative Graduate Education and Research Traineeship) programs at various universities. The goal of IGERT programs is to train doctoral students to competently work between and within multiple disciplines to solve complex real world issues. Many IGERTs have themes of sustainability, as complex sustainability issues are best addressed by drawing upon multiple disciplines. This particular breakout session focused on defining sustainability. Throughout the introductory conversations in the session, it was clear that many professionals (academics, practitioners, policy makers, etc.) still struggle with the definition and operationalization of sustainability. We noted that in our experiences as graduate students, the concepts central to sustainability issues are frequently lumped together to make a "stew", but often the recipe for that stew is hard to find. We debated whether there was an effective way we could use our experiences as students to design a post-secondary curriculum for those new to issues of sustainability, in order to provide guidance to researchers, policy makers, and post-secondary educators.

After that first session, our group met several more times to discuss the methods, concepts, and insights we wished we would have had access to as undergraduates. The group's major goal became to create one recipe, a helpful guide, for those learning about and teaching issues of sustainability. We hoped that professionals and students alike would find this guide, if not comprehensive, informative to their learning processes and research questions. We additionally made it clear that this was not an exercise to come up with solutions necessarily, but to "frame" the problem and create a space for problem solving. Framing the problem gives a tangible way to not only understand what "I personally am thinking" about an issue, but also a way to talk about it with others. A classroom exercise was therefore designed to address the following primary topics with students: 1.) Sustainability is inherently interdisciplinary, drawing upon fields as varied as engineering, sociology, ecology, anthropology, political science, and economics, 2.) The scales of problems vary from local needs of neighborhoods, towns, and villages to national, international, and even global issues, and 3.) Ethical issues are at the heart of the sustainability concept because it deals with human needs and relationships to the environment and power.

This paper is organized into three major sections: an introduction, description of the curriculum, and summary of preliminary student responses to the curriculum in classroom settings. Furthermore, the curriculum description consists of three subsections: introductions, the exercise, and follow-up. We intend for this paper to serve as a guide to both the direct implementation of our Sustainability Stew curriculum approach and also as an impetus to further develop and customize this approach to learning in the context of sustainability.

2. CURRICULUM DESIGN AND PROTOCOL

Our objective was to design an education module that could be used in different contexts with the flexibility to introduce concepts of sustainability in different disciplines. The Sustainability Stew Guide is therefore a classroom exercise to be imported into existing courses as a way to

introduce sustainability concepts and create an important bridge between traditional classroom settings and project- or problem-based learning. The classroom exercise consists of one in-class session (approximately 50 minutes, but tailored to allotted time). The following represents a generic form of the Sustainability Stew Guide as intended for the instructor. It is our intention that the facilitator (instructor, fellow student, or other "instructor") of the exercise could use this guide to craft his or her own exercise tailored to the audience and available time. We also present an example of an alternative/adapted presentation of this concept in the form of a semester final project.

2.1 Sustainability Stew Guide Part One: Introduction

Part One of the Sustainability Stew curriculum includes a chance for the presenters (when not the everyday classroom instructor) to introduce themselves, their research interests, and goals. This provides context and personal connection opportunities for the students. Next, a brief discussion follows, focusing on why sustainability is such a relevant and challenging concept to study while suggesting that the term is also difficult to define and can mean different things to different people, for example, to both researchers and members of the general public. After completing the brief introduction, students spend a few minutes responding to the following questions:

1. What is sustainability?
2. List five sustainability issues pertinent to your current location or hometown.

The purpose of this portion of the exercise is to get students thinking about sustainability without too much prompting from the facilitators. It is important to collect these responses to see how they vary when students are first presented with the issue, and to discover any trends that may appear. Students are guided in thinking about their responses and a discussion is created around the topic of sustainability. Specifically, the instructor assesses how students are "compartmentalizing" the problem, *i.e.*, what issues or factors are they specifically focusing on and what factors or issues are they ignoring? As a group, students create a list of what they identify as the main characteristics of sustainability.

2.2 Sustainability Stew Guide Part Two: The Exercise

Because this Guide functions as an introduction to sustainability concepts, the exercise works best when facilitators come to the classroom having already worked through a sustainability issue with the Guide. This gives the facilitators prior knowledge of the issue and reduces conceptual confusion. It is best for facilitators to choose a local issue that students can identify with if conducting this exercise in a single class period. However, the Guide can also be used as part of a longer-term class project on sustainability and, in such cases, class discussion could lead to selection of a sustainability problem for study.

After introduction of the problem, students are led through the Guide's four sections (parts A-D below). During this walk-through, it is important to engage students and ask qualifying questions as often as possible.

Sustainability Definitions: How Do You Define Sustainability?

Here, the facilitators ask for the students' definitions and present a brief description of sustainability using examples from the literature to show the different ideas and definitions that surround the concept and how they relate to what students wrote in Part One. Below is a list of common definitions we find compelling, each representing a slightly different concept:

> **Sustainability** is the "use of the environment and resources to meet the needs of the present without compromising the ability of future generations to meet their own needs. Maintenance of the productive base (total capital) over time." Chapin, Kofinas & Folke, 2009.
>
> **Sustainability** is "meeting the needs of the present generation without compromising the ability of future generations to meet their needs." Brundtland Commission, 1987.
>
> **Sustainable development** is "helping meet the world's growing energy needs in economically, environmentally, and socially responsible ways. In short, helping secure a responsible energy future." Shell Oil, 2007.
>
> **Environmental sustainability** is based on the fundamental rules of conservation:
> - Reduce dependence on non-renewable, non-recyclable materials
> - Harvest renewable resources no faster than they can be renewed
> - Produce wastes no faster than nature can absorb or break them down
>
> University of Alaska Fairbanks (UAF) Sustainable Campus Initiative, 2008.
>
> **Social sustainability** is creating "an enabling environment for people to enjoy long, healthy and creative lives." UAF Sustainable Campus Initiative, 2008.

Problem Framing: What are you Sustaining? For Whom, Where, When, and How?

After discussion of sustainability definitions, facilitators touch on the idea that an overarching definition of sustainability may never be decided upon, which is not necessarily a bad thing. The concerns encapsulated by the concept of sustainability are inherently interdisciplinary and will likely vary from problem to problem, influenced heavily by a frame of reference. Therefore, creating a clear description of the particular problem, and carefully assessing the issues associated with it, may be the best approach to defining sustainability. After again touching on the topic chosen for the classroom, facilitators walk through the following sections:

A. Sustainability of What?

Prompts: Are you interested in sustaining a way of life, standard of living, animal population, functioning ecosystem, or a continued flow of ecosystem services? The following is a list of topics to help you start thinking about the different kinds of things that can be sustained:

Natural capital, social capital, human capital, equality, quality of life, culture, system (ecological, political, social, cultural), yourself, family, species, consumption, health, civilization, ecosystem services, intrinsically valued ecosystems, economies, production, energy, environment, water, food security, human security, climate, society, morality, biodiversity, progress, growth, gross domestic product, development, religion

Qualifying Questions: Having decided upon a goal that you are interesting in seeing sustained, think about what would have to be stopped, lowered, or lessened in order to sustain your "What". For instance, will people have to give up a standard of living, remain in poverty, restrict their economic growth, or limit future development? In short, ask yourself what are the tradeoffs associated with sustaining this "What"?

B. Sustainability for Whom?

Prompts: Who are the stakeholders involved in the problem you have identified? For example, list the people dependent upon the sustainability goal, the people involved in regulation and lawmaking, or community organizations that influence the legal and social rules related to the sustainability goal. Consider those who will benefit as well as those who may be hurt. A short list of possible stakeholders to help stimulate discussion is included below:

You, families, communities, nation-states, humanity, politicians, scientists, children, corporations, marginalized groups, privileged groups, governments, powerless groups, future generations

Qualifying Questions: Having specified the stakeholders, consider who would be involved in your approach to solving this problem. Which stakeholders would you be excluding? Should you attempt to incorporate some of these viewpoints into your problem-solving approach? How will you engage stakeholders? Should these approaches differ among different stakeholder groups? Finally, think about your role in this problem. Which group do you fit into, and what biases does this give you in the approach you propose for solving the problem? Do you have decision-making power? Who is evaluating you (regulators, funding agencies, evaluators, the academy, media, peers, colleagues, etc.) and are your solutions designed to impress them more than they are designed to help stakeholders?

C. Sustainability When and Where?

Prompts: The sustainability of an action can differ greatly depending upon the temporal or spatial scale you are focusing on. Think about the scales, both spatial and temporal, at which your problem is being assessed. There is perhaps no better example of this than climate change. Consequences of carbon dioxide emissions can have far-reaching effects, and, in addition, a time lag in noticeable effects makes addressing the issue particularly difficult. Furthermore, the immediate pollutants from within one political border readily pass into the jurisdiction of another. Examples of potential scales are listed below:

<u>Spatial Scale</u>: Individual, family, community, region, nation, continent, globe
<u>Temporal Scale</u>: Daily, monthly, seasonal, annual, generation, lifespan, forever

Qualifying Questions: What base units are you using to describe your spatial extent: geographical (national boundaries), social (family networks), political (voting districts), economical (markets), or ecological (watersheds, forests)? Are the units you've chosen the most important for your issue? There is often a difference between the ideal scale and one that is practical. Are they different in the context of your problem and, if so, how have you tried to reconcile this? Similarly, address such questions for the units chosen to describe your timescales.

D. Sustainability How?

Prompts: The final set of considerations should focus on the historical context of the problem and what that will mean for implementation of solutions. An important question to ask is: how has the current state come about? Are the rules for a sustainability objective the result of careful planning and legislation, a result of age-old traditions and the wisdom of elders, or do they reflect a slap-dash approach to making as much money as possible as quickly as possible? Things to consider include:

Historical Considerations – Who were the stakeholders when the social and environmental patterns were first developed, and how do their needs differ from present-day needs? Have the stakeholders changed throughout time?
Context – How do the current stakeholders interact?
Power – Who holds the power over decision making?
Legitimacy – Does the researcher have a legitimate role in or connection with the issue? Are the "Hows" attainable?

Qualifying Questions: How have you defined your solution approach, and how have you defined the solution? What qualifies as a "solution?" Is the solution implemented using technology? Does it utilize local resources or does it involve importing knowledge and skill? Have you considered unintended (good and bad) consequences of the solution?

2.3 Sustainability Stew Guide Part Three: Wrap-up and Integration

This portion of the Guide involves reflection on and evaluation of the students' learning experiences. Students are prompted with questions like: Now that you have gone through this thought exercise, restate your problem and suggested approach. Has it changed? If so, what aspects have changed the most? Were there things that you failed to consistently account for?

It is important to generate a conversation that includes as many elements as possible, not necessarily the arrival at a conclusion or solution path. Our hope is that, in the context of sustainability, students feel more comfortable with a given conclusion or course of action by having gone through such a discussion process. Creating a culture of circumspect decision-making, where dialogue concerning sustainability is a necessary part of any solution, would have profound real-world implications in complex problem solving.

3. RESEARCH METHODS AND RESULTS

As a preliminary method of evaluation for the Sustainability Stew Guide, we designed a short questionnaire to obtain feedback on students' backgrounds, opinions, and views regarding the usefulness of the exercise. The questionnaire session allows our Guide to be an active process, tracking student responses over time and comparing demographic differences between students. Furthermore, it allows us to evaluate the efficacy of the Sustainability Stew Guide itself and provide feedback for instructors of the host classrooms.

3.1 Research Methods

To date, the Guide has been administered to one undergraduate sociology course at the University of Alaska Fairbanks in Fairbanks, AK (n=37), one community college course at Delaware Technical and Community College in Newark, DE (n=11) and one graduate-level research group at the University of Delaware (n=7), for a total sample student population of 55. We chose classrooms based on our desire to expose the Guide to students of varying years of education, areas of study, and a presumed degree of exposure to the issue of sustainability. After working through the Sustainability Stew Guide, we gave students a 10-question Likert scale survey (see Salant and Dilman 1994 for a detailed description of Likert scale methods) to review the curriculum and four open-ended questions including the student's major, hometown, and inquiry into what types of sustainability the student personally relates to. Table 1 shows Questions 1-10. Responses to the Likert scale Questions were requested according to a set ranking from one to five (1=strongly disagree, 2=disagree 3=neural, 4=agree, 5=strongly agree), with space provided for optional written responses and feedback. Note that Question 1 inverts the positivity as compared to all of the other Questions, asking if the Guide was *not* helpful instead of asking if it was helpful, in order to ensure the students were reading the questions. Therefore all figures show the raw results to Question 1, denoted as "Q1" as well as the inverse of the results, denoted as "(Q1)".

Table 1. Post-exercise survey and questionnaire handed out to students.

Likert scale questions, requested according to a set ranking from one to five (1=strongly disagree, 2=disagree 3=neural, 4=agree, 5=strongly agree)	
Q1	This exercise was NOT helpful in formulating my ideas on sustainability.
(Q1)	This exercise was helpful in formulating my ideas on sustainability.
Q2	This sustainability guide would be beneficial to me in other classes.
Q3	Sustainability is an important concept to understand for anyone, regardless of major, degree, or
Q4	This guide would be helpful for my career after graduating.
Q5	Sustainability is a term that is often misused in the media, political arena, and in public discussions.
Q6	Sustainability is a difficult concept to address in just one class period.
Q7	"Sustainable" development is different than "green".
Q8	I am an environmentalist.
Q9	Sustainability is a confusing term that is too hard to define.
Q10	I plan to attend graduate school.
Open ended questions	
1	What is your background and/or major area of study?
2	Where are you from? How long have you lived there? How long will you stay?
3	How are issues of sustainability important to you personally?
4	Do you have any suggestions for us on improving the guide? Is there anything we didn't explain well or anything that confused you in particular?

We compiled and reviewed the data looking for qualitatively-significant trends. We sought to assess students' overall experience of the curriculum and the perceived usefulness of it as a learning tool. We also looked for trends among demographic data. It is our goal to continue to collect and analyze data from the implementation of this Guide so that we can eventually assign a more quantitative significance to our results. At this time, however, we can only report preliminary results from the survey and from our observation as instructors.

3.2 Findings

Trends emerge from these preliminary tests of the Sustainability Stew Guide that we feel are valuable for evaluation of the Guide during this ongoing development and implementation stage. First, we can measure the "effectiveness" metric for the Guide with Questions 1-5 (Questions shown in Table 1, results shown in Figure 1). In the ideal case, regardless of background and prior exposure, we hoped to achieve a highly positive response to Questions 1-5. The "ideal" outcome, representing maximum "effectiveness" of the Guide, would thus be expressed by strongly agreeing that: 1.) The Guide was helpful, 2.) That it could be useful in other classroom environments, 3.) That sustainability is an important concept to understand, 4.) That the Guide would be useful outside the classroom environment, and 5.) That the term sustainability is currently misunderstood. Thus a student for which the Guide has been 100% "effective" would

score a total of 25 points on Questions 1-5 (with the inverse of Question 1 factored in). In this way, we can use the "effectiveness" measure as a way to evaluate and improve the Guide. A histogram of this result is shown in Figure 2, where 100% effectiveness corresponds to a cumulative answer of 25 to Questions 1-5. The histogram is broken into bins of 5%. From this plot we can see that the vast majority of students' responses fell into the range of 61-85% "effective." While our aim is to ultimately have data from hundreds of students, it is encouraging to see a strongly positive response from the participants in the exercise thus far.

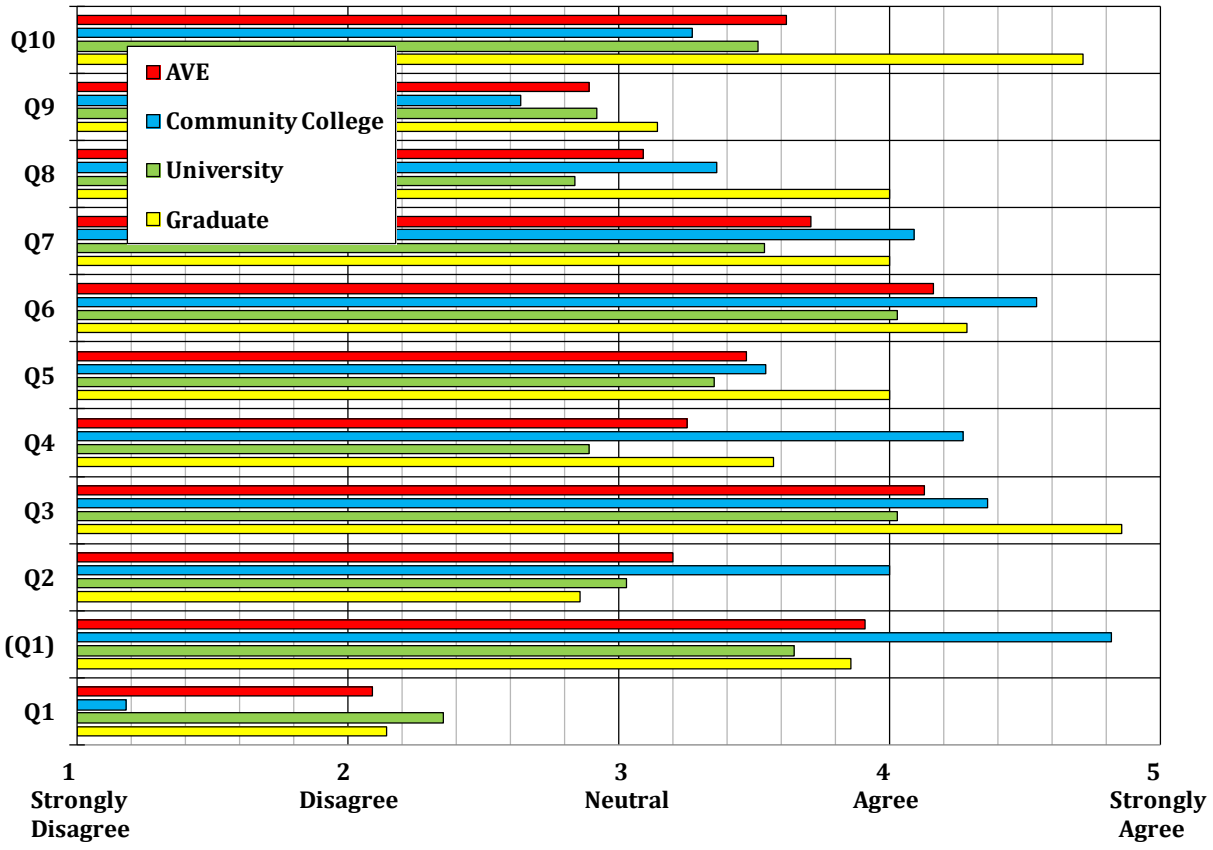

Figure 1: Student responses to the Likert scale survey given after each Sustainability Stew Guide exercise. Figure shows responses to Questions 1-10 including the inverse of Question 1, "(Q1)". Responses vary on a scale of 1-5, and are shown for each student-type (community college, university, and graduate), then compared to the overall average for each question (labeled AVE and shown in black).

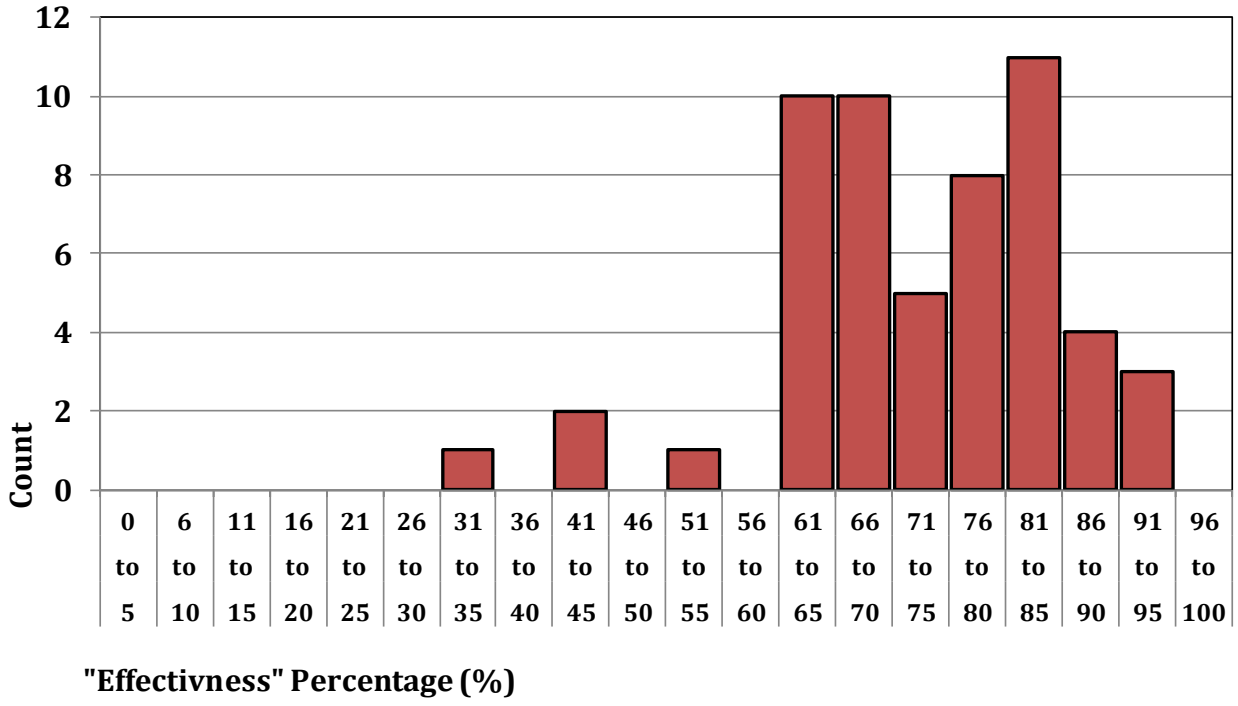

Figure 2: Overall student perception of Guide effectiveness. Effectiveness estimates calculated as cumulative responses to Questions 1 through 5. Thus 100% effectiveness would be represented by a score of 25. Most students found the Guide to be moderately effective (median = 72%).

Some interesting pairings of survey questions offer insight into the background and attitudes of the students to whom we administered the Guide, in particular when assessed by student type. Figure 3 pairs the results of Questions 3 (“Is sustainability important?” and 8 (“Are you an environmentalist?”) for all students. Answers for these questions appear to correlate, suggesting that self-identified "environmentalists" are likely to feel that sustainability is important. However, our data indicate that even students who felt strongly that they were not environmentalists still found the issue of sustainability somewhat important. While the correlation is not extremely strong, no responses were found above the linear correlation line.

When broken down by educational level, much more variation existed at the university level than at the community college and graduate level. For instance, to the question "is sustainability important?" (Question 3) average variation from the mean (4.20) was 0.68, 0.46, and 0.24 points on the Likert scale for university, community college, and graduate levels, respectively. When asked whether sustainability was too hard to define in Question 8, responses averaged around neutrality (mean) for the three groups combined, while the community college, university, and graduate levels answered 2.65, 2.9, and 3.1 respectively. When compared to results from Question 1, we see that community college students felt very strongly that the Guide was helpful (4.8; Figure 4), while the university and graduate students felt that the Guide was slightly less helpful (3.75; Figure 4).

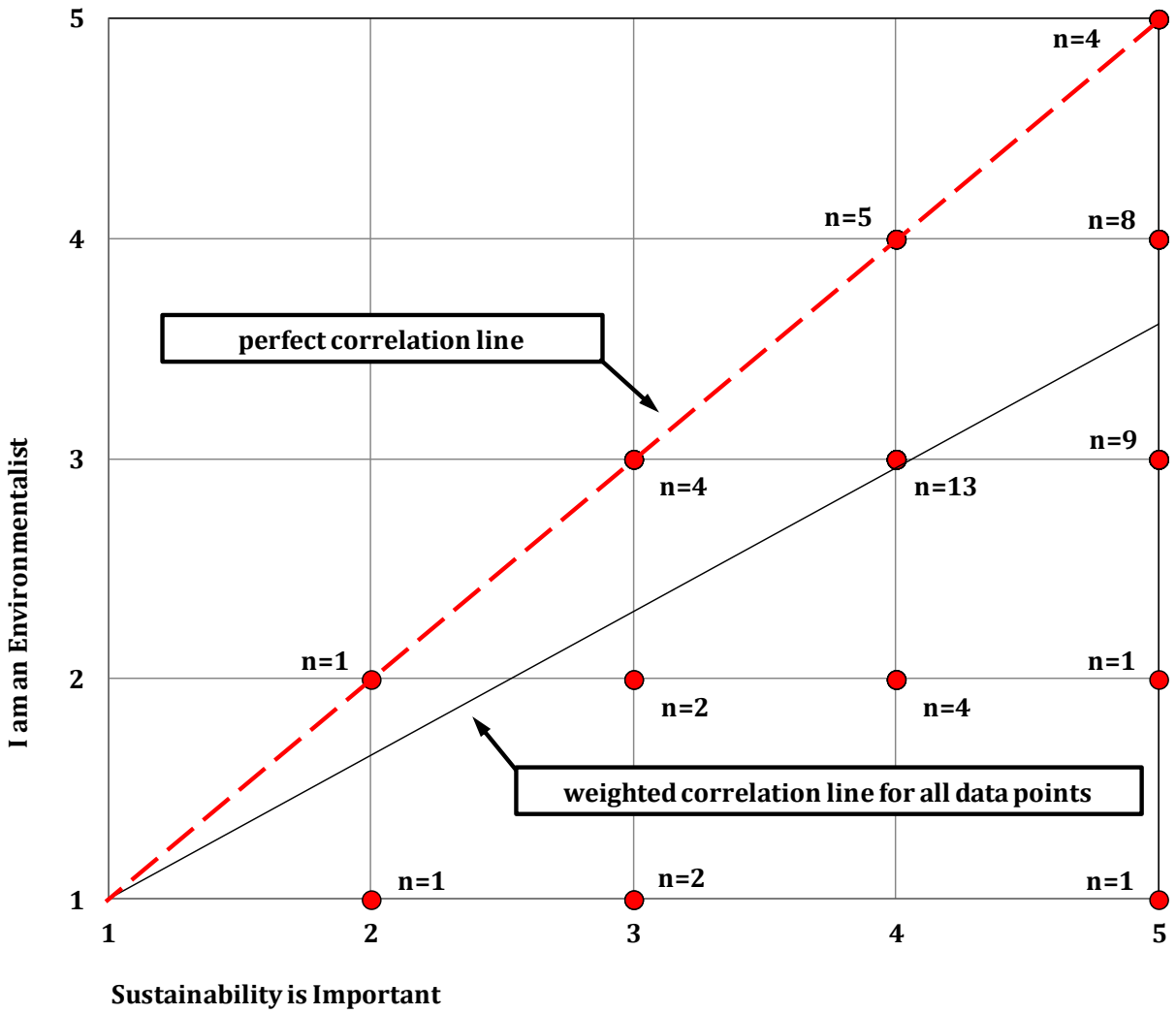

Figure 3: Likert scale responses to the two statements "sustainability is important" and "I am an environmentalist" (Questions 3 and 8). A response of 1 indicates strong disagreement, while a response of 5 indicates strong agreement. Responses to these questions correlate, though not strongly due to small sample size and a narrow range of integer responses. Number of responses at each data point is indicated. The weighted correlation line is shown for the two statements. For comparison a perfect correlation line is shown.

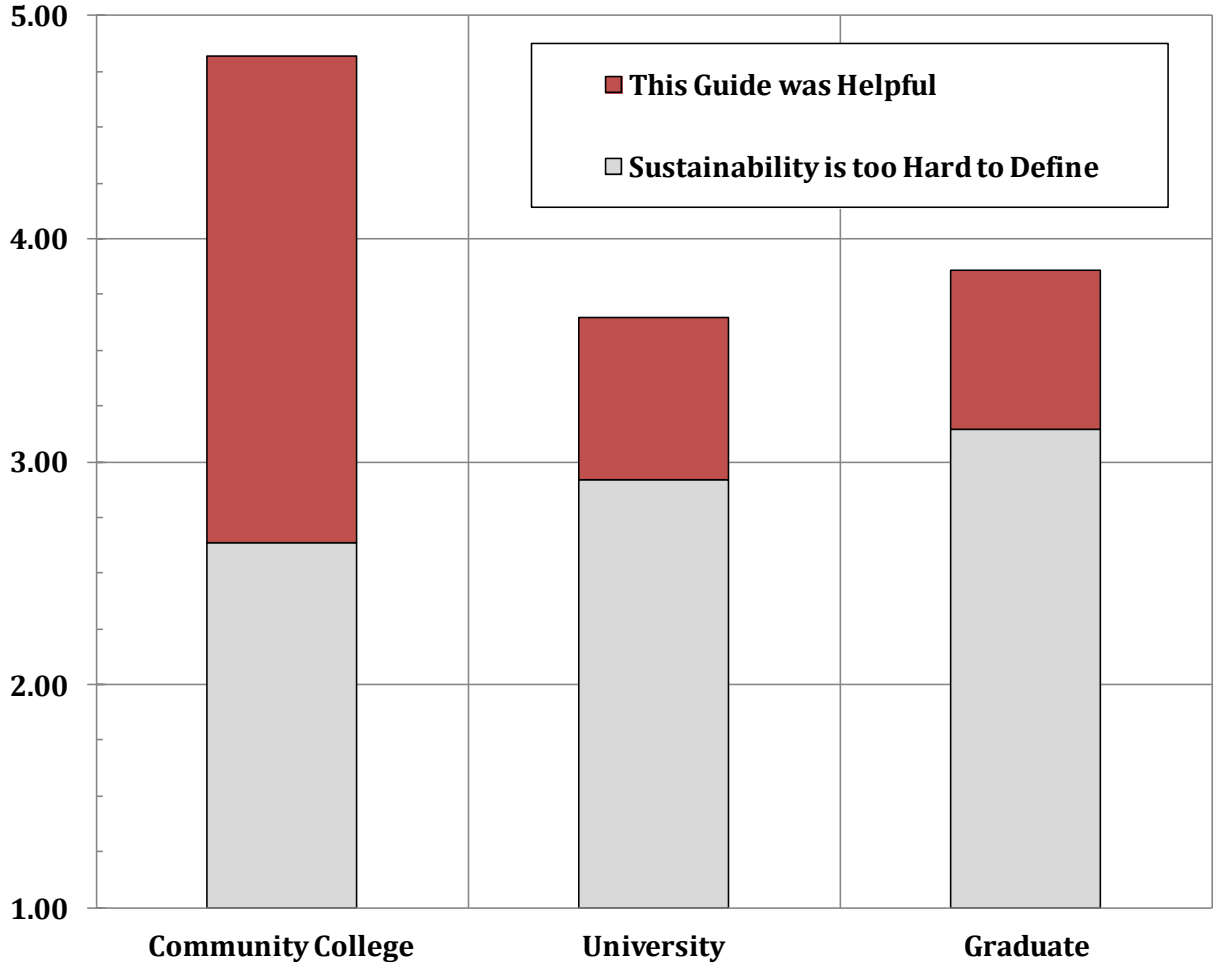

Figure 4: Comparison of Questions 1 and 9, by student-type groups (community college, university, and graduate). Community college students showed the largest disparity between feeling that the Guide was helpful and that sustainability is too difficult to define.

In general, Question 1 alone offers the most significant assessment of the effectiveness of the Guide. By grouping the Likert scale into three levels defined as "disagree," "neutral," and "agree," (1 or 2, 3, and 4 or 5, respectively) we found that 73% of students *disagreed* that the Guide *was not* helpful (Figure 5). It also shows that 18% of students were neutral in their responses and 9% agreed (Figure 5). This result is encouraging, especially considering that a full 18% of students answered with neutrality or below when asked if sustainability is an important issue at all (Figure 1). This suggests that the Guide does a good job of reaching students who are willing to entertain the idea that sustainability is important in the first place. If we removed the 18% mentioned above, this would raise the percentage of people who felt the guide was helpful to 89%.

Demographic data collected in our surveys were also insightful. The first open-ended question asked the student's area of study. We were able to break this information into five categories: engineering, sciences, arts, technical, and undecided. The "technical" classification pertained to

people interested in being technicians in any particular field, for example information-technology, automotive mechanics, certified energy auditor, etc. When looking at how these five categories responded to Question 2 ("Is sustainability an important issue?"), we found a highly positive response across the board (Figure 6). Students who self identified as "scientists" responded most positively to the question with an average of 4.5, while students claiming to be "undecided" or "engineers" had the weakest response (4). It seems the importance of the issue of sustainability, regardless of chosen area of study or work, is widespread.

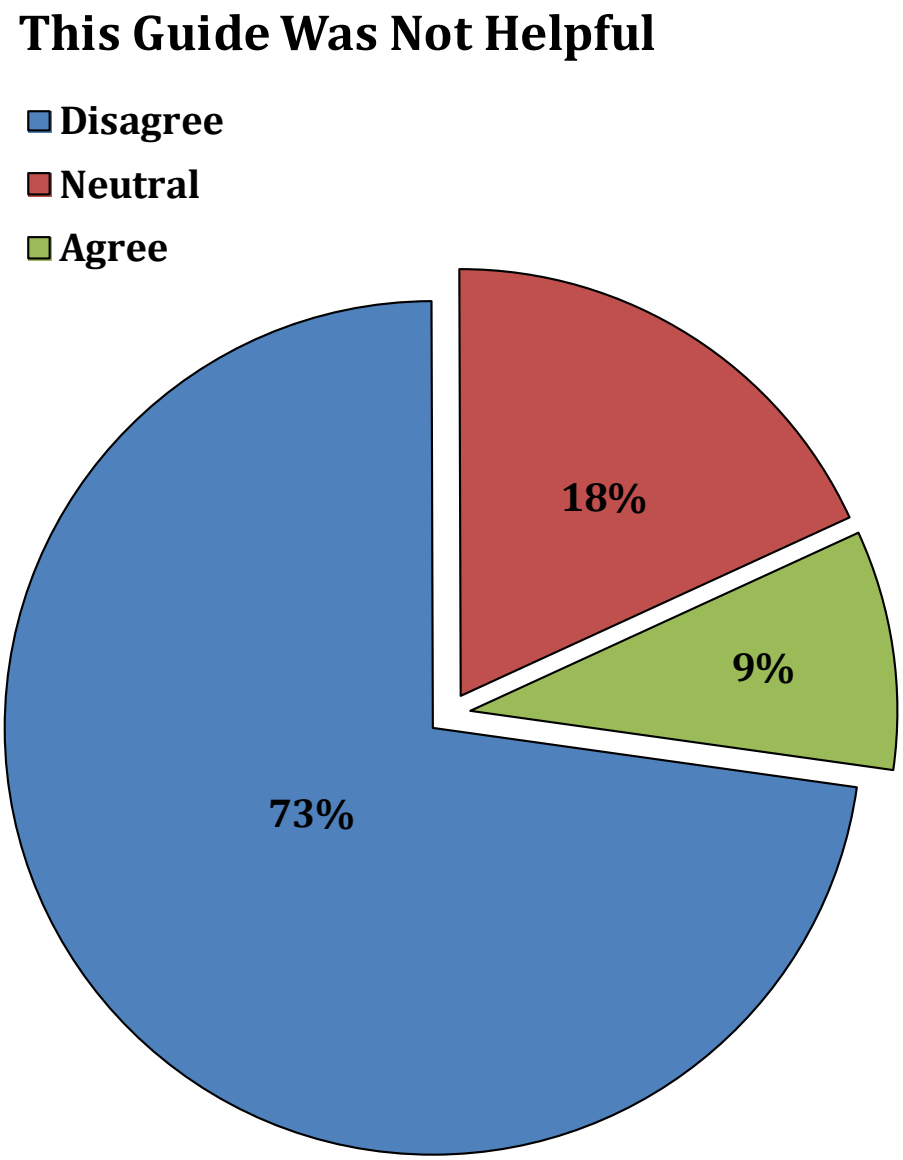

Figure 5: Overall student responses to Question 1: "This exercise was NOT helpful in formulating my ideas on sustainability". Possible responses included "Agree" (1-2), "Neutral" (3), and "Disagree" (4-5). The majority of students (73%) disagreed with this statement, indicating that the Guide was useful to them.

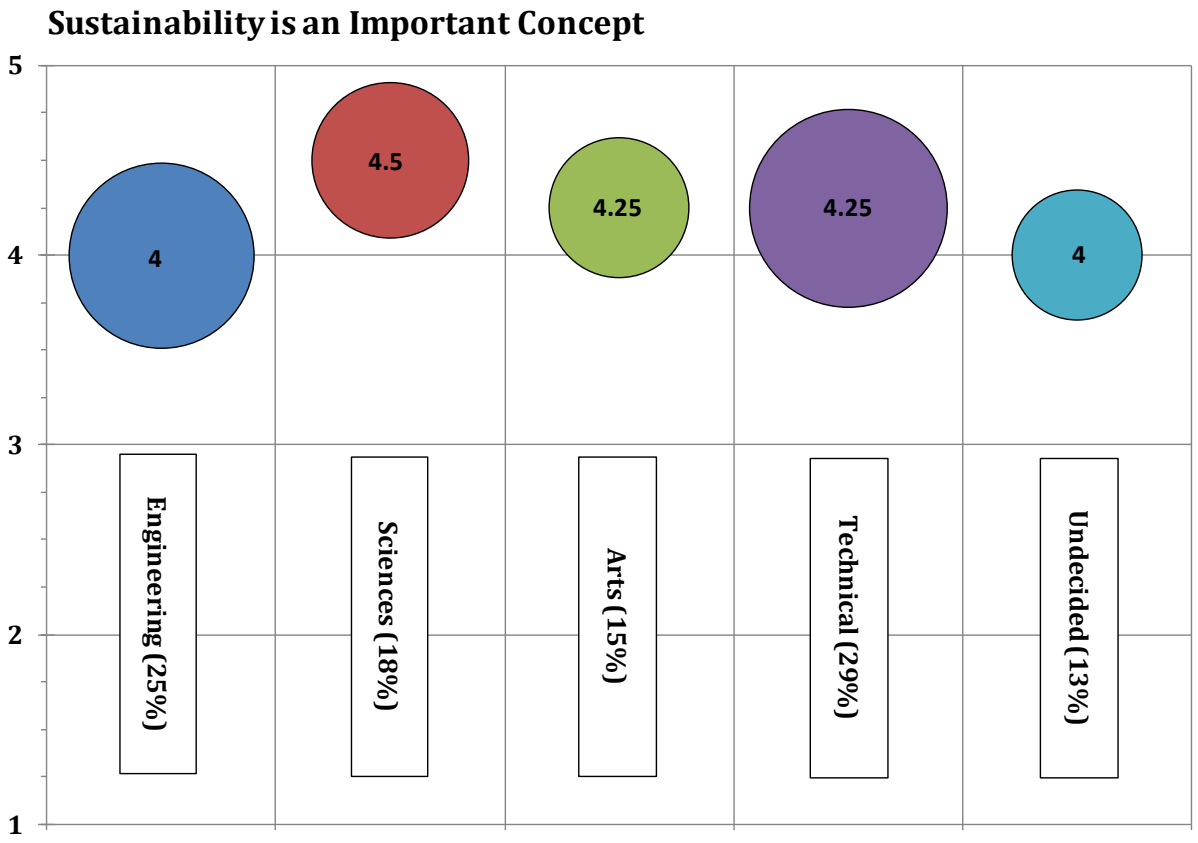

Figure 6: Average Likert scale values assigned by students in response to Question 2: Is sustainability important? Responses displayed by self-identified areas of study. Circle size reflects the proportion of students in each area of study with specific percentages listed in parentheses. Most students considered sustainability to be an important concept with average estimates varying from 4 to 4.5.

3.3 Discussion

In addition to data gathered in the questionnaire, we also recorded our personal observations on student responses to the exercises. In general, we found students to be genuinely engaged and curious during the discussions, which was an encouraging observation. We attribute this to the ability to tailor the topic of the Guide to an issue of local importance. During the exercises and in conversations with students afterward, a few common impressions related to the Guide emerged. It was repeatedly observed during the graduate student section that participants wanted to rigidly and mathematically define sustainability as a precursor to the discussion process. This tendency seemed to limit the scope of the exercise, and at first the discussion seemed too focused. In addition, some students brought substantial prior experience into the discussion on the topic of sustainability, including students whose own research was essentially focused on defining sustainability in specific contexts, like energy or agriculture. We noted that, depending on the audience and their prior exposure to issues of sustainability, slight modifications to the Guide and instructor approach could foster better discussions. For example, the presence of even a single vocal student with significant prior experience to the issues can run the risk of curtailing

other students in the exploration process. In such a situation it can help if the facilitator is very active in limiting the knowledgeable students' participation, perhaps through making it necessary to be called on by the moderator to speak. On the other hand, minimal moderator intervention is preferable if the conversation seems balanced.

The Guide is broken into the five major categories exploring the "what, who, when, where and how" of sustainability. Is this a sufficient categorization for facilitating conversation, or does it place too much emphasis in a particular direction? For example, would it be helpful to add the category of "why" to specifically address the issues of fairness, blame, and other human-centric associations with the term sustainability? Even though this issue seems to inevitably come up during discussions within the other categories, are we deemphasizing it by not including it directly?

Some students felt that the goal of the Guide was not clear enough in the beginning. We felt that stating a clear goal up front might detract more from the conversation but at the same time we recognized that too much freedom in the exercise can make it disjointed and less valuable. While the general goal could be stated as "problem framing and discussion generation," this phrasing will likely prove too vague for some people. For others, however, it can be almost too specific because of prior word-associations that are very powerful. To an engineer, the word "problem" might set the student off in the direction of "solution" right away, though creating a solution is not necessarily the goal of the Sustainability Stew Guide.

From the open-ended survey and discussions during the sessions, a few dominant sustainability-related themes arose: energy, water, food, and raw materials seemed to be issues that students consistently associated with the word sustainability. These are issues that are generally associated with the word sustainability in mass media. However, regardless of prior exposure to any media-centered associations with the word sustainability, students still seemed fully capable and willing to go well beyond the buzzword version of sustainability and ask the pertinent questions as outlined in the Guide. This observation was encouraging because it suggested that while the word sustainability is being increasingly used, it has not yet garnered a stigma or dogma that would represent a serious barrier to learning.

3.4 Limitations

The most striking limitation of this study is the small sample size of students. This is a problem easily reconciled, however, and we are in the process of conducting more classroom exercises. An additional limitation in our understanding of student responses to the Guide could have been the selection of classrooms used for the exercise. In one of our cases, no personal relationship existed between facilitators and the students, which might create incentives toward dishonesty during the exercise or conversely, improve participation through a longer-term relationship. We did not factor data about the facilitator into our analysis, but the structure of the Guide aims to minimize variations due to facilitator technique. One way to remedy this concern in relation to assessing the Guide is simply to increase exposure to the Guide. It also might be possible to have students complete their surveys online so that the results come directly to our database and are not intercepted by the classroom instructor at all. This approach might provide an opportunity to add a survey question that attempts to assess the students' perceptions of the instructor's

effectiveness in general, thereby giving us the opportunity to identify participants who already have a negative relationship with that particular classroom environment. Another concern is that the classroom context could create a type of bias in the survey results. Students may be more inclined to respond positively to the survey because they feel that the exercise is in some way endorsed by the instructor and being critical of it could reflect poorly on the student. While the surveys were anonymous, particularly in small classroom settings, true anonymity can be diminished in the eyes of the student. It could be beneficial to implement the Guide outside a classroom setting to account for this fact, but it is often difficult to recruit participants in large numbers unless they are already gathered, and students would be self-selecting to participate in the Guide in that case, which could add another source of bias.

Lastly, there could exist a distinct difference between the *way* the guide is "helpful" to graduate students and the way it is helpful to undergraduates (see Wagner et al. 2012). Differences of this nature may not be well captured in our current questionnaire. We are considering the development of a supplemental survey that is education-level specific. The results of this type of a survey could help develop, for example, research methods for solving graduate-level sustainability problems using an approach similar to our discussion and problem framing Guide. We are additionally refining questions on the survey to better track our results.

4. CONCLUSIONS AND FUTURE WORK

As part of the ongoing process of development for this guide, we have considered many different applications. One such application involved translating this approach into a semester wrap-up project, in which groups were created and a report and presentation were prepared on a problem of the student's choosing. As part of the NRG103 course at Delaware Technical and Community College led by Dr. Budischak (after an introductory lesson by author Erik Koepf at the beginning of the semester), students were asked to wrap up the semester with a final project on problem framing in the context of sustainability (Appendix 1). Students formed three groups in the class, and focused on "water", "suburban sprawl," and "the rainforest". This approach seemed to work particularly well because the Guide had been implemented at the beginning of the semester, and the students were familiar with the process. However, in the form of a standalone final project, the Sustainability Stew approach still could have significant value. Having extra time to examine, frame, and discuss problems in a group setting allows the students to go much deeper into the subject matter. We are in the process of developing a shortened Guide presentation that could be used as an introduction to a semester final project that would only take 15-20 minutes instead of an entire class period. Additionally, we envision the future of this Guide as something that can be used in K-12 education as well as graduate-level education. The Guide is flexible enough that educators would be able to modify the detail and duration of the program to fit classroom needs.

With the distribution of this Guide, we hope that educators will implement it in some form and report back their findings. We are in the process of creating an online resource that will allow for this form of data collection. This resource will eventually be capable of hosting an online forum, allowing for up- and downloading of lesson plans and related projects, as well as reporting survey results. At this time, however, it is limited to the reporting of survey results, as we feel this information will be extremely valuable in the further development of the Guide. To

download the Sustainability Stew Guide and a sample lesson plan, and to report survey results, please visit the Sustainability Stew Guide at www.illuminatelearning.com/sustainability.

Sustainability is indeed a difficult concept to define and explain, let alone utilize or operationalize. Too often it is used as a buzzword in traditional media outlets. As founders of the Sustainability Stew Guide, we would like to include more experiential-based learning tools, such as site visits and guest visitors to the classroom. For example, adding group work over longer periods of time could aid in a deeper learning process (Warburton 2003, Hiller Connell et al. 2012). The encouraging results reported here have invigorated our efforts as researchers and educators to share the Sustainable Stew Guide and to pursue its further development and implementation by using experiential education methods to design a novel approach to sustainability curriculum.

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APPENDIX

NRG 103 Final Project: Framing a Sustainability Issue or Problem

You goal for this assignment is to come up with an issue that you think has to do with sustainability and frame it in a similar way to the coastal erosion problem we framed in the first class. Your issue could be as large as global climate change or as small as recycling at Del Tech Stanton Campus. Once you have picked an issue, you will answer these questions about your problem:

- Sustainability of what?
- Sustainability with/for whom?
- Sustainability when and where?
- Sustainability how?

Once you have framed the issue, you should also come up with a potential solution to your problem and examine the social, economic, and environmental impacts of your solution.

For this project you will be working in groups with a ***maximum of 4 students*** and you will need to write a report (five page maximum single spaced 12 point font) and give an oral presentation (15 minute maximum) on your findings. These will be graded with the rubrics on the following pages. These are both due by the last day of class on **12/08/11.**

A short written progress report (less than half a page) must be handed in by the beginning of class on **10/20/2011.**

Try to pick an issue that interests your group and if you need help coming up with some ideas just ask.

Appendix 1: Final project handout to NRG103 at Delaware Technical and Community College, Stanton Campus. These were the same students that the Guide was delivered to at the beginning of the semester.

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