In the Zone: Vygotskian-Inspired Pedagogy for Sustainability

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ABSTRACT

In this study, Lev Vygotsky's (1978) Zone of Proximal Development (ZPD) provides inspiration for a teaching approach for sustainability in a social science discipline, where students often lack or have widely varied levels of foundational understanding. This qualitative case study describes intellectual processes and aspects of the educational experience of student participants experiencing such an approach. This study suggests that this approach is useful for filling gaps in understanding about this inherently complex concept while maintaining student engagement, useful in disciplines where the integration of sustainability is slow or in transition.

INTRODUCTION

One of the broadest gaps in the sustainability education (SE) literature is the lack of practical pedagogical approaches for such (Everett, 2008; Reid, 2002), especially deplete for social science disciplines that have been slower to integrate SE. A consequence of inconsistent integration is that learners often arrive to sustainability-related topics with widely varied levels of foundational understanding, making learning about this complex concept especially daunting. Therefore, as social science disciplines make their transition to SE, pedagogical advances are needed now to navigate learners as well as educators through the transition. The concept of Lev Vygotsky's Zone of Proximal Development (ZPD) (1978) may inspire an effective approach.

Pedagogical approaches to SE are highly correlated with a constructivist epistemology (see Armstrong, 2011 for a complete discussion). Perspectives on constructivism are diverse, positioned along a continuum and vary in emphases about where knowledge is constructed. Three domains of constructed learning include: Endogenous (cognitive construction prompted by previous knowledge), exogenous (external construction influenced by the environment), and dialectical (prompted by interaction between the learner and subject) (Moshman, 1982). This latter perspective has been chiefly influenced by Vygotsky (1978) who emphasized the transformation of knowledge through interactions between the learner and the environment. This perspective is most analogous to SE, as it is partial to social interaction, collaboration, and experiential learning with others.

Central to Vygotsky's (1978) perspective is the concept of the Zone of Proximal Development (ZPD), a realm in which learning conditions can be optimized through the identification of competences that the learner could mature if only with the right assistance. Recently, Sir Ken Robinson gave a talk "Changing Education Paradigms" on TED.com, telling the story of a recent and surprising rainfall in Death Valley that resulted in a rich bed of wild flowers. He concluded that Death Valley is not dead but dormant and used this as an analogy for learning: the seeds of possibility are always just beneath the surface. Likewise, one may consider the ZPD a dormant strip of ground on which the educator may identify those seeds in the learner and water them appropriately. With appropriate stimulation, the learner begins to reach beyond their current level of development for new learning, the educator carefully guiding the learner to circumvent paralysis or boredom.

The pedagogical implication of this concept is that the instructor introduces information and resources responsive to the learner's current developmental level. Then, the learner continues to refine their conceptual landscape through reciprocal learner-instructor and learner-peer interactions. Though Vygotsky emphasized peer collaboration, he was partial to learner-expert interaction, which exposes the learner to an expert's conceptual process, thrusting them beyond their current level of development until they become more autonomous in their own understanding of the subject.

Sustainability is inherently complex, and without the benefit of foundational knowledge, can be overwhelming to digest. Conversely, if instruction is simplified to accommodate lower levels of understanding among some students, other learners may become bored. Further, providing a baseline of foundational background about sustainability is often impossible to incorporate in an already overflowing curriculum. Therefore, the use of the ZPD concept may be useful inspiration for an approach to accommodate existing gaps in understanding when and where they are needed while maintaining student engagement.

The purpose of this study was to experiment with an approach inspired by the ZPD to ascertain how the concept may enhance teaching and learning for sustainability in a context where learners have widely varied levels of foundational understanding. The researcher utilized this approach when presenting sustainable design content to students in a senior-level interdisciplinary product development course. A qualitative case study was conducted to understand the student experience.

Schunk (2008) argues that studies related to constructivism should not necessarily accentuate the truth or falsehood of constructivist assumptions, but aim to describe the process by which the construction of knowledge happens in the learner and what the social, developmental, and instructional elements are that most impact that construction. Likewise, Vygotsky (1978) also emphasizes the need to examine internal processes, like an x-ray, to determine how the educational experience stimulates intellectual processes. Responsively, the central research question guiding inquiry for this study was: How do students who receive this approach in the context of sustainability describe their learning experience? Notably, Tobias (2009) submits that while there is resounding popularity for constructivist teaching methods, there is little empirical data available to support them. Therefore, a key feature of this study is the description of the educational experience, as reported by the student.

THE ZONE OF PROXIMAL DEVELOPMENT: IMPLICATIONS FOR TEACHING

To reduce the gap between the learner's current development and where they could be with assistance, learning experiences must be designed to encourage the learner to pursue exercises slightly beyond their current capabilities. Fundamental here are interaction and dialogue with others, which prompts mental contradictions inside the learner, engaging the learner to develop new knowledge to quiet this disequilibrium

(Vygotsky, 1978). This new construction is often an improvement of what came before and is uniquely reliant on the social situation to bring them about (Cobb, 1996; Liu & Mathews, 2005; Moshman, 1982).

Vygotsky (1978) placed particular emphasis on cultural transmission of language in social activity, making dialogue key to the process, especially when it prompts internal dialogue. The language used during social interaction is later used for an internal dialogue, contributing to the reorganization of thought through reflection (Moshman, 1982). Vygotsky (1978) emphasized the role of reciprocal interaction with an expert, which may include guiding, modeling, and discussion with learners by an expert (Hodson & Hodson, 1998) as well as the timing of feedback given to motivate the learner to construct more new meanings (Pressley, Harris, & Marks, 1992). Given too early may cause boredom, while given too late the learner may become overwhelmed and frustrated (Vygotsky, 1978). In sum, the learner practices expert performances by interacting with someone more knowledgeable, their conceptual process evolving upward toward the expert's. Once foundational components are fully absorbed, the learner gradually becomes more autonomous (Hodson & Hodson, 1998).

Essential to this approach is the use of proper scaffolding. These guide points support the learner as they initially begin to learn a new concept and may include creating tasks for the learner that are sensitive to their personal interests and knowledge level, providing an environment in which contradictions between the learner's and the expert's method can be easily revealed, and demonstrating strategies to complete tasks (Pressley et al., 1992). Proper scaffolding ensures personally relevant learning experiences for the learner when they are ready. Over time, the scaffolding is gradually withdrawn as the learner becomes more responsible for his or her own knowledge construction.

The complex, uncertain, and especially values-laden nature of sustainability can easily transport a learner of average cognitive means into an intellectual land mine if not appropriately guided. Here, exercises involving experience, dialogue, and feedback can be critical for staging opportunities to expose mismatches between the learner's preconceived notions and a more appropriate worldview through a reciprocal exchange of knowledge. Most importantly, gaps in rudimentary knowledge can be filled during this exchange when the learner signals their readiness to comprehend. Thus, rather than comprehensively presenting sustainability content in a didactic fashion, which may be impossible and may exhaust the learner, the reciprocal nature of this approach inspired by the ZPD concept may be exceptionally useful for talking the learner through the complexity in situations where foundational knowledge is missing.

METHODS

A qualitative case study was conducted at a large land grant university in the Midwest with fourteen undergraduate seniors (13 females, 1 male). Enrollment was kept low to ensure ample interaction. Participants were enrolled in an apparel product development course, a program requirement for all undergraduates specializing in apparel marketing or design. The researcher was the instructor for the course. At the time of this study, sustainability had not been integrated into the curriculum in an organized or holistic way; only minor course modifications were made to include lectures or modules about sustainability topics. Thus, this was an ideal setting to explore the use of this approach to fill anticipated gaps in foundational knowledge.

DATA COLLECTION AND ANALYSIS

Student reflections on learning were collected twice during the semester, at mid-term and during finals week. During the required reflective writing, students were asked to

discuss the most important things they were learning, what was helping them learn, and what the learning experience was like. Additionally, an outside moderator conducted focus group interviews during the final weeks of the course.[1] During these interviews, students were asked to discuss what most helped them learn about sustainability and what the experience was like. These focus groups were recorded and transcribed by a third party, and transcripts were delivered to the researcher after final course grades were submitted.

An inductive coding procedure was employed during analysis to identify emergent themes found in both the student reflections and focus group interviews (Yin, 1989; Stake, 1995) that would address the study's central research question: How do students who receive this approach in the context of sustainability describe their learning experience? The researcher found it helpful to categorize data according to important intellectual processes described by students and the aspects of the educational experience that had stimulated those processes, as recommended by Vygotsky (1978). Then, using selections of the data from each category of data, the researcher began identifying emergent themes most frequently discussed by participants and developed a preliminary coding rubric, including definitions and rules for application. The preliminary rubric was then applied to other selections of the data, refining the definitions and rules of application until the best fit was achieved. Since the researcher was the instructor in the course, a professor from another college served as a peer debriefer throughout analysis, meeting with the researcher frequently to review the procedures being used and independently coding segments of the data to increase its validity and ensure the themes were indeed emergent (Creswell, 2007). Finally, the completed comprehensive rubric was applied across the study's data.

THE APPROACH

The apparel product development course was an ideal candidate to introduce sustainability content as social, environmental, and economic challenges in the industry span the product development cycle from materials selection to consumer use and disposal. The semester project in the course was to develop a sustainable product development proposal, requiring the application of sustainable design principles. Students learned about sustainable design perspectives such as Industrial Ecology, Product Service Systems, Cradle-to-Cradle, and Design for Well-being as well as strategic marketing concepts like the Triple Bottom Line.

The ZPD concept inspired an approach that was utilized during approximately eight weeks of the course when the above concepts were being explored. The approach involved lesson plans designed to present a basic framework of each concept. The rule of thumb was to provide enough information to set students on a course of action. A typical lesson plan included the presentation of several key principles, a brief discussion, audiovisual support or images illustrating the concept, and then an activity requiring students to apply the principles to an apparel product development context. Students would work in small groups to design a garment or brainstorm an apparel-marketing concept, allowing time for students to dialogue with each other about their ideas as well as conduct research on their computers.

When an activity began, the instructor would observe, watching for confusion or confidence, and when detected, she would approach. She encouraged students to first develop their own questions and explain what led them to the question. Sometimes the instructor would directly identify gaps in understanding and provide information or resources to fill it. At other times, the instructor would talk with the student in a

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[1] The author, the researcher in the case study, was not involved in the process of obtaining the participants' consent to participate in the interviews.

reciprocal way to answer the question, sometimes offering an industry example or a personal experience to illustrate the concept's application. Once confidence was exhibited, the instructor would plant an additional piece of information (e.g. a resource, idea, or story) or ask a question that would require the student to go one step further.

Generally, the formal presentation of each concept was kept brief, permitting ample room for students to interact with their peers and the instructor during an activity. This offered opportunities to infuse missing foundational knowledge when the student was ready to receive it. For instance, when teaching students about the Triple Bottom Line, a concept which uses the tenets of social equity, environmental health, and economic viability to create business strategies that balance sustainability principles, students were asked to use a set of cards presented in McKeown's (2006) Education for Sustainable Development Toolkit, each citing a sustainability principle. These were used to brainstorm apparel product development strategies. The principles were not directly and obviously tied to apparel business, prompting the student to make the connection. In this exercise, confusion ignited early, exposing substantial gaps in foundational knowledge among the students. For example, one principle was, "Cities grow within predetermined community boundaries" (e.g. current city limits). Unfamiliar with concepts like Urban Growth Boundaries (UGB), the instructor was able to introduce this concept during the activity and use a real apparel industry example of how this principle might be implemented. Once understood, students could proceed to brainstorm apparel-retailing strategies that could reduce a business's eco footprint. Later, the instructor challenged students to rethink retail space altogether, brainstorming to find ways to create an engaging shopping experiences without a physical space. In this case, a concept like UGB's, not typically part of the apparel curriculum, was introduced to fill a knowledge gap and extend the student's appreciation for sustainability's complexity when students became ready for it. Notably, this strategy allowed the instructor to fill needed gaps and bring all students to similar understanding.

A comparable strategy to feedback was utilized on group assignments submitted to the instructor for grading. When confusion in the work was evident, the instructor wrote only direct comments identifying points on which the student lacked understanding. Often, the instructor would follow her written feedback with verbal interaction during class in an effort to cement confidence and push the student beyond their current level of understanding. On the other hand, when comprehension of a concept was articulated strongly in an assignment, the instructor would write recommended steps that could be taken to further explore and expand the ideas proposed in the work, offering a creative idea or an additional resource.

RESULTS

The following discussion of results is organized by two primary categories, themes related to the intellectual processes students most frequently noted as most important to their learning about sustainability and the most frequently discussed aspects of the educational experience students felt most facilitated those intellectual processes. Table 1 provides a summary of the study's themes for each category, illustrating support by theme, participant, and data type. An annotation is given to each participant number indicating when the participant discussed the theme: First or second reflection (1, 2); first or second focus group interview (1, 2).

Students who experienced the teaching approach inspired by the ZPD concept described several intellectual processes they considered essential to learning about sustainability in this course. First, participants discussed the continual correlation between the course content and their own personal lives, which increased their engagement and investment in course activities:

Table 1

Intellectual Processes and Aspects of Educational Experience Described by Study Participants

Category	Themes	Source(s)	
		Written Reflections on Learning	*Focus Group Interviews*
Important Intellectual Processes for Sustainability Learning	Personal relevance	P001_1 P007_1 P012_1 P013_1 P014_1 P002_2 P005_2 P007_2 P012_2	P001_1 P002_2 P003_2
	Suppositions challenged	P004_1 P005_1 P006_1 P007_1 P008_1 P010_1 P001_2 P003_2 P004_2 P005_2 P006_2 P007_2 P008_2 P011_2 P012_2 P014_2	P002_1 P007_1 P001_1 P001_2
	Socially reliant outcomes	P001_1 P002_1 P003_1 P004_1 P006_1 P008_1 P011_1 P012_1 P001_2 P002_2 P003_2 P004_2 P005_2 P007_2 P008_2 P012_2 P013_2 P014_2	P006_1 P001_1 P003_1 P002_2
Aspects of Educational Experience Prompting Intellectual Processes	Responsiveness to individual	P008_1 P010_1 P002_2 P007_2 P008_2	P003_1 P002_1 P007_1 P004_1 P005_1 P006_1 P001_1 P001_2 P002_2
	Interaction with others	P001_1 P003_1 P004_1 P005_1 P007_1 P009_1 P010_1 P011_1 P012_1 P001_2 P003_2 P005_2 P006_2 P008_2 P009_2 P010_2 P011_2 P012_2	P006_1 P002_1 P001_1 P003_1 P005_1 P002_2 P001_2 P003_2
	Interaction with expert	P001_1 P007_1 P009_1 P010_1 P001_2 P002_2 P003_2 P004_2 P006_2 P009_2 P011_2 P013_2 P014_2	P002_1 P003_1 P004_1 P002_2 P001_2
	Feedback loops	P003_2 P006_2 P009_2 P011_2 P012_2 P013_2 P014_2	P007_1 P003_1 P002_1 P005_1 P003_2 P001_2

P004: After learning about the [sustainable design principles], then applying them to activities inside class that we can relate to ourselves and our ideas, it makes it easier to understand what they are talking about; what components go into each paradigm. After the activities I sometimes still think of ways to apply or change what I have learned. (Reflection 1)

P007: Learning how different scenarios could potentially play out in my life and the lives of others by the way the world changed really had me thinking outside of class for quite a while. (Reflection 1)

Notably, many students arrived at the course with negative preconceptions about sustainability and were not necessarily personally engaged in the topic when the course began:

P001: Personally, I was kind of turned off about sustainability before taking this class… (Interview 1)

P010: I'm not one of the 'go green' people. (Reflection 1)

Though personal relevance increased over time and became a key feature of the learning experience, it did not come easily. Subsequently, participants also described a tendency for their suppositions to be challenged. Many participants discussed a transformation, contradiction, or an extension made to what they knew previously and how this was essential to understanding sustainability at a deeper level:

P007: ... I think going into it too my whole mindset of the whole thing was that [sustainability] is for other people. It's not something that everyone is going to have to be concerned about, the people that really actually care are going to take care of it and whatever. After being in the class for as long as we have been it is like an industry wide issue. (Focus Group 1)

P008: An epiphany that I have had throughout the entire course was the major increase in my understanding of sustainability and sustainable design. For example, my preconceived ideas of sustainable design before I began this course were that they were very outlandish and expensive and not something that anybody would really be wearing on a daily basis, if at all. I had in my mind pictures of high fashion runway shows in which models were wearing clothes made out of recycled metal and other very strange things. But, I learned that sustainable designs are not really this at all …(Reflection 2)

Interestingly, one of the most powerful themes was a seeming interdependence among students for personal learning, according to participants. Some students indicated that their learning experience in the course was characterized by a reliance on or engagement with others to arrive at high quality outcomes, and this was essential to their learning, especially when applying sustainability to course work:

P012: My group members also helped very much. Early on in the course we really started acknowledging one another's strengths. Once this had taken place it really made it much easier for us to work as a group. Since we were able to combine our strengths and, in turn, improve upon our weaknesses we were able to produce work that each of us were proud of ... (Reflection 2)

P011: In past classes I am usually the one who just sits and listens and does what other students suggest. I am now speaking up during class discussions and also expressing my ideas to the group and asking them to help me expand on the idea and make it more creative and one-of-a-kind. (Reflection 1)

Though students found their learning highly dependent on others, this was sometimes impeded by a general lack of collaborative skill. Students discussed varying levels of adversity that occurred in the group that sometimes made engagement a challenge:

P010: As a group we definitely started out on the wrong foot. We weren't really working as a team . . . we obviously had some communication problems this semester when it came to working on [assignments]. We kind of just left the whole lab to one person to be in charge of completing. (Reflection 2)

P006: I struggled with our interaction through an inability to find that mutual understanding . . . for example, [a group member] and I seem to butt heads the most of anyone in the group, not only because our ideas very different, but so are our thought processes. (Reflection 1)

It is questionable if learning would have been as socially derived had the instructor not been as involved in the student groups.

Audible among participants were aspects of the educational experience that seemed to prompt these intellectual processes considered important to sustainability learning. One theme was the perceived responsiveness of the instructor to their current understanding. Some participants emphasized the instructor's ability to "… speak English about these ideas and concepts" (P007, Reflection 2). Other participants emphasized the instructor's willingness to adjust her approach to increase understanding and reduce stress. For instance, one particular lesson plan related to Cradle-to-Cradle (infinite material recyclability and reuse) was especially challenging for students, primarily due to a lack of materials knowledge about the biodegradability and recyclability of fibers. After a challenging day in the classroom, the instructor went back to the drawing board, re-working the lesson, and then reviewing it again during the next class period. This flexibility made a seemingly indelible impression on participants:

> **P004:** ... if we don't understand she really stops and either reformats the lecture; there was one where it was really confusing and we were just sitting there like 'Uh I don't even know how to go about doing this assignment.' So, the next class she had reworked it and presented it in a way and it made so much more sense. I think she was aware that we were confused and went back, so that was helpful to all of us. We were able to see everything from different ways that were more understandable. (Focus Group 1)
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> **P002:** I agree, [the instructor has] been really good about checking back with all of us to make sure we are on the right track, so none of us are overwhelmed ... she's always very aware of how we're doing and if we seem really exhausted or just everyone's really tense, she'll kind of just feel out the atmosphere and ask us what would be the best case scenario. (Focus Group 1)

One of the most frequently discussed themes related to aspects of the learning experience that influenced important intellectual processes was their interaction with others. Participants especially associated this interaction with learning about sustainability, particularly the ability to talk through their lack of understanding and navigate the seeming complexity with their peers through application exercises:

> **P012:** Many times our group would find ourselves discussing the material more in-depth and explaining parts that we needed more clarification on. Being able to talk to others about the material, especially when you have the context of the project, really helped me learn. (Reflection 2)
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> **P009:** Discussing these [sustainable design principles] has made it a more interactive learning experience, which is ideal for my learning style. I can read chapter after chapter of information, but I really don't grasp a concept until I discuss it out loud. (Reflection 1)

Relatedly, participants also frequently discussed the value of interacting with the instructor, benefiting from her expertise. Participants identified the instructor's high level of involvement in their work as a coach and facilitator as pivotal, some identifying her as an important source of ideas and resources that broadened their understanding:

> **P001:** …having an outside opinion enter into our group work ... sometimes I think people are so focused on a single idea that they forget about other ideas, so having a fresh mindset enter the group can spark new ideas. (Reflection 1)
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> **P004:** Because we can tell how much information [the instructor] has, it might not

be necessarily be what she presents, but she brings in other sources like a lot of the recommended readings and stuff has really helped just broaden all of our knowledge. (Focus Group 1)

Participants also discussed the feedback provided in the classroom and course assignments as a chief mechanism to stimulating intellectual processes about sustainability, considered particularly exceptional when compared by students to other course experiences:

P003: I feel like we had a lot of feedback, probably more feedback than I feel like I've had in a lot of courses. Even throughout any of the other assignments [the instructor] was very detailed on things that we needed to work on and I feel like that's a lot more feedback than I've gotten in the past… I think that helps you learn a lot better because you not only are 'Okay I got a B or an A on this assignment' you're also thinking 'Okay, well, how can I make sure I get that 100% next time.' It gives you kind of a goal to reach on your development. (Focus Group 2)

P003: It's a great balance of it, too. It's not just overly critical or 'everything was awesome!' ... Just even with [the instructor] going back through and making comments on it like, 'Maybe you should try this or that,' that was really helpful, because it's hard to see all the different pieces and components that go into it when you're in the middle of it. So, having her be this unbiased mediator sort of and giving her thoughts on things, that was really beneficial to me. It was a good mentor sort of thing and made me realize things from a different point of view. (Focus Group 1)

Though participants responded positively about the responsiveness, interaction, and feedback that characterized this learning experience, one of the challenges articulated was a seeming lack of appropriate scaffolding; meaning, topics or assignments were sometimes introduced before the learner could digest previous concepts, and this disrupted learning:

P005: Or I think we'll be working on the lab and then [the instructor] will start talking about the next [assignment] and by the time you start working on that next lab you don't have all that information fresh on your mind. (Interview 1)

P007: My head just gets caught in between [assignments]. I am constantly thinking 'which one are we doing?'… I think on the other side of the coin though, with all the stuff [the instructor] wants to accomplish that might be the only way that it can get done. (Interview 1)

The researcher redeveloped the course in this case for the study without the benefit of textbooks or other materials that often aid proper scaffolding. It was, indeed, challenging to determine the appropriate introduction and chronology of some concepts and tasks, especially without knowing what the gaps in knowledge would be. As a consequence, topics in the course were not always seamlessly juggled, appearing muddled in the student's mind.

DISCUSSION

In the current case, a pedagogical concept approach inspired by Vygotsky's (1978) Zone of Proximal Development (ZPD) was utilized in an apparel product development course to introduce sustainable design principles to students who lacked foundational knowledge about sustainability. According to student participants, learning about sustainability via this approach was characterized by some key intellectual processes

(personal relevance, suppositions challenged, and socially reliant learning), which were facilitated by some important aspects of the educational experience (responsiveness to the individual, interaction with peers, interaction with expert, and feedback loops). Notably, participants characterized this experience as unique compared to other courses.

Chiefly, students were not immobilized by the presence of sustainability and its complexity in the course, though for most, this was the first time the concept was introduced in a comprehensive way. Although students did perceive complexity and breadth, they were able to navigate these attributes during the learning process, though the inappropriate timing of some course concepts and tasks sometimes complicated this learning. Most importantly, participants seemed to exit the course with a holistic conception of sustainability that was both practical and personal.

Secondly, according to participants, course topics chiefly came alive through interaction and application with others. Though Vygotsky (1978) placed emphasis on learner interaction with an expert, participants seemed to hold both peer and instructor interaction with similar regard, sometimes preferring to discuss ideas first with their peers before engaging the instructor. Particularly in regards to learning with peers, this learning was sometimes impeded by a general lack of collaborative skill, limiting engagement. Students also noted the challenge of some course topics and how their pre-conceptions or misperceptions were contradicted, especially for students who arrived at the course with negative preconceptions about sustainability. But these were addressed when the instructor recognized confusion or concern and would adjust her approach to fill the gap.

Most importantly, learners felt their conceptions about sustainability became more accurate over time, increasing their ability to relinquish old ideas and embrace new ones. The feedback loops provided by the instructor responsive to the individual learner, both verbal and written, were an important conduit for keeping the learner invested in progressing to the next level. Additionally, the perceived interdependence by participants on each other for learning was notable, readily acknowledging the magic that can occur with others.

Though the novelty of the approach taken in this course must be considered with these findings, there are some important implications to be made for teaching sustainability in a discipline that has just begun to integrate the concept. One, as educators, we need not present a comprehensive backstory about sustainability. Rather, we may find it beneficial to learners to leave some blanks in the narrative, permitting students to chart their own conceptual map at their own pace. It is often tempting to want to bestow upon students the wide landscape of topics and issues about sustainability, but it may be best to alternatively guide students through their own exploration of that landscape, traversing according to their own personal curiosity and interests. This requires a flexible plan that is light on information dissemination and heavy on exploration, activity, and interaction. This approach requires flexibility and a broad approach to knowledge. Designing student projects that do not impose a singular perspective about sustainability but provide ample room for learners to develop their own questions can be complicated. In the current case, the instructor permitted students to renegotiate the terms of an assignment. Some student groups took advantage of this policy, which enabled them to pursue some aspects of an assignment more than another. Interestingly, in these cases, students often negotiated themselves into more work, though this work yielded a much higher level of engagement, investment, and accountability.

Further, the involvement and collaboration with peers seemed especially critical to making this exploration about sustainability engaging and personal. True to Vygotsky's philosophy about dialogue, talking to each other was important to learning about sustainability, even if some struggled to communicate effectively. When students could share what they thought and have it contradicted by others around them, it led

to improved perceptions of sustainability and a more holistic view. Additionally, as sustainability challenges are on a scale to which they are unlikely to be solved in solitude the importance of developing cooperation among learners in the educational context cannot be underestimated. This requires both time and a physical space conducive to such work. This approach also requires the development of course assignments that incentivize learners to be interdependent with others in their problem solving; projects that require more than one mind to accomplish. But, this collaborative approach also requires the instructor to be a skilled facilitator, assisting in the development of cooperative skills among learners. In the current case, the instructor played the role of a fellow collaborator, modeling what she desired from students, who soon followed suit.

Additionally, it was important to participants that the instructor paid close attention to their reactions during activities, reducing temporary anxiety and maintaining their engagement. Moreover, the ability to talk to the instructor frequently and receive continuous feedback was a substantial benefit. This requires knowledgeability, or at least additional resources, on the part of the instructor. If expertise is lacking, the instructor may benefit by involving outside experts in the classroom. Further, the ability to maintain close contact with students and provide generous feedback becomes much more difficult, though not impossible, in a large classroom setting.

This final implication, an obvious limitation of the current study, merits further discussion. In the current case, enrollment was kept low to ensure a high level of interaction with learners and increase the researcher's ability to observe the student experience and respond accordingly. As institutions of higher education are increasingly under pressure to become more efficient while the number of college entrants increase, small classes are becoming a luxury. Some study participants commented on the perceived benefit of a smaller class, perceived to raise the comfort level and empower students to share their ideas and experiences without feeling intimidated. Conversely, the same course offered in a lecture hall style would have likely been far less engaging as learners would have not been permitted to refine conceptions of sustainability through reciprocal interaction.

Nevertheless, when a small classroom setting is preferable but not possible, some alternatives may be available. Designing activities and assignments that require the learner to make their conceptual process and opinions known are helpful for making the opportunity to provide contradictory feedback plentiful. These mechanisms may also be used to elicit peer feedback. In a similar sustainability course offered online, the researcher used online message boards, Wiki's, and blogs to create perceived intimacy that encouraged students to express themselves and receive feedback without being in a physically intimate scenario. Further, though students in the current case received ample individual feedback, they also frequently received feedback as a group, which was much less time consuming for the instructor. The researcher is currently experimenting with providing group feedback via audio recordings, which has further increased efficiency and made feedback more personal and descriptive. Students in this case also seem to better understand how they can improve. Yet, the researcher has utilized the approach used in this study in a sustainability course with 60 students and found it helpful to utilize a graduate assistant who was knowledgeable about sustainability to play a similar role as the instructor.

Whatever the set of parameters, we have important choices to make when we integrate sustainability. This study has provided support for the use of an approach inspired by the ZPD, keeping the learner engaged when a foundational background in sustainability is lacking and learning about the topic could otherwise seem insurmountable. Further investigation is needed to explore the use of this approach in different learning contexts, such as varied class sizes or online vs. face-to-face interactions. Additionally, more

empirical research is needed about the application of this method through the use of the broad array of emerging technologies that may be used to engage students, increasing the opportunity for feedback loops. ∎

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