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Implementing Education for Sustainable Development: The Potential use of Time-Honored Pedagogical Practice from the Progressive Era of Education

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Abstract: Education for sustainable development (ESD), a UN initiative, is an emerging field and a movement advocating for a reorientation of education. Integration of ESD has been slow, especially in higher education. The most notable progress is marked by campus greening and research initiatives, while pedagogical innovation, the topic of this paper, has been much slower to develop. Reid (2002) posits that the implementation challenge may be complicated by ESD's lack of concrete direction, however, the possibilities of adopting time-honored educational practices for this purpose as well as allowing ESD to extend educational practice is compelling. The purpose of this paper is to explore some of those time-honored educational practices which may be highly symbiotic to ESD's intent, specifically, those characteristic of the Progressive Era of Education (PEE) in the 1930's. It could be easily argued that ESD is simply a second chapter in PEE. More importantly, since the two movements embody great kinship, the pedagogical predilections of ESD may be better understood by exploring those of PEE; namely, constructivism, and especially dialectical constructivism; learning characterized by active engagement and social interaction. The following discussion first explores pedagogical theories and strategies associated with ESD and then correlates those with that of PEE. Finally, a repertoire of practical action using constructivist teaching methods that may be taken into the classroom to implement ESD is outlined.

Keywords: Sustainability, curriculum, education, progressive, constructivism, dialectical

Education for sustainable development (ESD), a UN initiative, is an emerging field and a movement advocating for a reorientation of education (UNESCO, 2005). ESD emphasizes the development of citizens and stewards who have knowledge, skills, and values that support sustainable behavior, civic engagement, as well as viable employment and a better quality of life (Egan, 2004; Kevany, 2007; UNESCO, 2005). Central in this approach is preparing learners for lifelong learning, an adaptive quality that makes the learner more malleable in a time when most societies are experiencing dramatic social, environmental, and economic transformation. Consequently, this reorientation is thought to require an entire reconceptualization of *how* and *what* learners should learn (UNESCO, 2005).

Integration of ESD has been slow, especially in higher education (Bossellmann, 2001; Everett, 2008; Rode & Michelsen, 2008). The most notable progress is marked by campus greening and research initiatives, while pedagogical practice, the topic of this paper, has been much slower to develop (Cotton, Bailey, Warren, & Bissell, 2009; de le Harpe & Thomas, 2009; Sterling & Scott, 2008; Wals, 2009). The ESD framework, described by organizations such as UNESCO and Forum for the Future, has been left intentionally ambiguous to allow for its tenets to be implemented by specific disciplines (Haigh, 2005; Stables & Scott, 2002), as this approach

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is thought to best align with how educational programs are organized and administrated as well as how teachers are professionally trained (Stables & Scott, 2002). Haigh (2005) argues that the ESD movement, spanning nearly 30 years, has not been wanting for lack of expansive numbers of organizations, international caucuses and summits, and declarative documents in its name, but by confusion about *how* to respond to the charge (Wals & Jickling, 2002). Indeed, learning outcomes associated with ESD have been described in the literature with eloquence and rich description, while largely absent from the literature are specific, *practical* directions for achieving them (Everett, 2008; Forum for the Future, 2004; Landorf, Doscher, & Rocco, 2008; Reid, 2002; Rode & Michelsen, 2008; Svanström, Lozano-Garcia, & Rowe, 2008).

Reid (2002) posits that the implementation challenge may be complicated by ESD's lack of concrete direction, however, the possibilities of adopting time-honored educational practices for this purpose, as well as allowing ESD to extend educational practice, is compelling. The purpose of this paper is to explore some of those time-honored educational practices which may be highly symbiotic to ESD's intent, specifically, those characteristic of the Progressive Era of Education (PEE) in the 1930's. In light of the current economic crises, ESD has been responsive to criticism about the industrial model of education, a seemingly *un*-sustainable system (Foster, 2002; Haigh, 2008; Orr, 2004). Rees (2003) posits that the current industrial model of education does not have to teach *un*-sustainability*;* the doctrine is naturally inseminated throughout, rooted in corporate globalization and the traditional production-to-consumption model. This model is thought to place the greatest value on a fragmented, positivist, reductionist transmission of knowledge rather than an exploration of the interaction of systems (Foster, 2002; Haigh, 2005; Kenan, 2009; Wals & Jickling, 2002; Sterling & Scott, 2008). Similarly, following the stock market crash of 1929, the industrial model of education came under fire. Education as a central driver of economy was drawn into question. Proponents of PEE advocated for a shift in the nature of education to better support a healthy democracy. The PEE called for a decentralized approach to education, responsive to local and cultural contexts, preparing the learner for quality life in the community, at home, and at work. Schooling for such purpose would emphasize the *how* as much as the *what*.

It could be easily argued that ESD is simply a second chapter in PEE. More importantly, since the two movements embody great kinship, the pedagogical predilections of ESD may be better understood by exploring those of PEE, namely, constructivism, and especially dialectical constructivism in which learning is characterized by active engagement and social interaction. Many of the pedagogical theories associated with ESD evidence a strong relationship to this approach to learning. Thus, better understanding these epistemological roots may better inform *practical* implementation of ESD. The following discussion is organized to first explore pedagogical theories and strategies associated with ESD, and then correlate those with that of PEE. Finally, a repertoire of practical action that may be taken in the classroom to implement ESD is outlined.

ESD and Pedagogical Theory

Orr (2004) posits that graduates today lack a value for land and community, something difficult to transmit through course content alone. Instead, altering *how* we teach, whatever we teach, *can* develop those values. Consistent with this philosophy, pedagogical theories associated with ESD emphasize the development of values supportive of sustainable development (SD). Concepts such as deep learning (Warburton, 2003), problem-based learning (Dale & Newman, 2005), transformational learning (Kevany, 2007), experiential learning (Ellis & Weekes, 2008; Jucker, 2002; Sipos, Battisi, & Grimm, 2008), active learning (Ellis & Weekes, 2008;

Svanström et al., 2008), action learning (Sipos et al., 2008), participatory learning (Jucker, 2002; Malhadas, 2003; Rode & Michelsen, 2008;), applied learning (Kevany, 2007) inquiry-based learning (Ellis & Weekes, 2008; Murray & Murray, 2007), critical pedagogy (Welsh & Murray, 2003), service learning, and critical emancipatory pedagogy (Sipos et al., 2008) have all been included in pedagogical discussions about ESD. Further, many authors have associated ESD with interdisciplinary (Bartlett & Chase, 2004; Calder & Clugston, 2003; Dale & Newman, 2005; Everett, 2008; Malhadas, 2003; Reid & Petocz, 2006; Rode & Michelsen, 2008; Sherren, 2008; Wright, 2002), multidisciplinary experiences (Dale & Newman, 2005; Everett, 2008; Jucker, 2002; Malhadas, 2003), and trans-disciplinary approaches to education (Jucker, 2002; Sipos et al., 2008). Indeed, authors conceptualize *how* to go about ESD in a variety of ways (Reid, 2002). All seem to connote some fundamental similarities: Meaningful social interaction, personal reflection, real life problem-solving, and a broad view of knowledge; all undoubtedly underscored by their penchant for bringing the learner to terms with themselves and the world they live in.

Pedagogical Strategies for ESD in Six Parts

Pedagogical strategies associated with ESD are expansive. To inform strategy in a practical way, they are organized here first by central themes related to the primary purposes of ESD: Strategies for the development of knowledge, skills, and values that support sustainable development (SD); and then by overarching strategic themes: Reality modeling, the ESD educator, and authentic assessment.

Reframing Knowledge

How must discipline-specific content be altered to align with ESD? Two major thought streams emerge in the literature. The first is to create a sustainability lens, situated to precede traditional content, while the second is to infuse SD throughout the curriculum, to reframe content entirely to support SD. The former thought stream has been suggested by McKeown (2006) who recommends creating a lens through which all course topics can be perceived, a lens of citizenship and stewardship. When students understand the guiding principles of sustainability, this framework can be used to perceive *all* content (Jucker, 2002; Svanström et al., 2008).

The latter strategy, far more ambitious, describes a curriculum redesigned for breadth, in which the subject matter is used as the conduit to teach sustainability (Calder & Clugston, 2003). Inherent in this approach are multiple perspectives and a demonstrated relationship between the discipline and the ecosystem (Stables & Scott, 2002; Rode & Michelsen, 2008). Interrelationships between social, environmental, and economic perspectives on local and global levels embedded in the subject matter are central to this strategy (Filho, Manolas, & Pace, 2009; Jucker, 2004; Stables & Scott, 2002). Bossellmann (2001) suggests this approach is made more plausible when the curriculum is focused on problems related to subject matter, rather than the subject matter taken singularly. This approach is not a case of adding *more* content, but *reframing* for sustainability.

Related to reframing content, themes in the literature also advocate for the development of various types of literacy related to sustainability (Forum for the Future, 2004; Murray & Murray, 2007), such as cultural literacy (Everett, 2008), eco-literacy (Haigh, 2008; Jucker, 2002; Wright, 2002) as well as political, social, and historical literacy (Jucker, 2002), urban ecology (Calder & Clugston, 2003) and traditional ecological knowledge (Sipos et al., 2008). In other words, the mechanics of sustainability impacts related to subject matter must also become a part

of the curriculum. Further, Bowers (2001) adds that educators must be aware and root out language, namely the taken-for-granted root metaphors in the delivery of subject matter that perpetuate unsustainable cultural patterns. These root metaphors like anthropocentrism, progress, patriarchy, and individualism dominate disciplines and largely diminish the ability to identify and adopt new, more ecologically sound understanding. Strategies to accomplish this end include intergenerational emphases, accentuating the principles of voluntary simplicity and ecological design as well as the study of cultural patterns.

Developing Skills that Support Sustainable Development

There are also a number of skills for which ESD advocates should be developed during educational experiences. These skills are largely related to citizenship and stewardship (Kevany, 2007; Stable & Scott, 2002), supporting sustainable behavior, civic engagement, as well as viable employment and a better quality of life (Egan, 2004; Kevany, 2007; UNESCO, 2005). Skills associated with ESD are expansive, including collaboration and cooperation, conflict resolution, creative, imaginative, and real-world problem-solving (Dale & Newman, 2005; Egan, 2004; Filho et al., 2009; Jucker, 2002; Svanström et al., 2008), future-mindedness (Rowe, 2000; UNESCO, 2005), knowledge transfer, meaningful communication and civic engagement, social sophistication (Eagan, Cook, & Joeres, 2002; Everett, 2008; Kelly & Fetherston, 2008; Kevany, 2007; Svanström et al., 2008), social action (ACPA, 2008; Haigh, 2008), negotiation (Kevany, 2007), interdisciplinary and transdisciplinary research skills, adaptive learning, contextualization of issues (Dale & Newman, 2005), personal introspection (Schlottman, 2008), visioning and gaining buy-in (Egan, 2004), the ability to identify and adapt to change (Filho et al., 2009), systems thinking (Dale & Newman, 2005; Filho, et al., 2009; Herremans & Reid, 2002; McKeown, 2006; Sipos et al., 2008), and values-focused thinking (Keeney, 1992; Sipos et al., 2008). Admittedly, learning outcomes for ESD emphasize *process* as much as facts-based learning, the *how* as much as the *what* (Dale & Newman, 2005). Some of the most common strategies for the development of these skills include collaborative activities, systems instruction, reflection (Schlottman, 2008; Warburton, 2003), multigenerational analysis (Haigh, 2008), democratic dialogue (Landorf et al., 2008), problem-based assignments, inquiry, action research (Warburton, 2003) stakeholder analysis (Collins & Kearins, 2007), role-play (Colluci-Gray, Camino, Barbiero, & Gray, 2006) modeling thought processes, offering multiple perspectives on topics, backcasting, and scenario building (Dale & Newman, 2005).

Developing Values that Support Sustainable Development

Murray and Murray (2007) stress that education must go beyond knowledge and skills to include the encouragement of values that support SD. Values supportive of SD that are most frequently cited in the literature include care, respect, charity, social and economic justice, commitment, cooperation, compassion, self-determination, and self-reliance (Filho et al., 2009; Murray and Murray, 2007), self-restraint (Haigh, 2005), and empathy (Kevany, 2007; Haigh, 2008). The College Student Educators International (ACPA, 2008) describe a set of attributes that change agents should possess that may also be considered in the discussion: Resilience, optimism, tenacity, commitment, passion, patience, emotional intelligence, assertiveness, persuasiveness, empathy, authenticity, ethical self-awareness, competence, and curiosity (p. 1).

Notably, ESD is not about the indoctrination of these values, but the articulation of them. Orr (2004) cautions that persuasive appeals to learners about values supportive of SD are likely to be ineffective. However, when values are made explicit by the learner, these can be called out and challenged (Dale & Newman, 2005; Forum for the Future, 2004; Murray & Murray, 2007;

Warburton, 2003). Strategies like iterative reflection can be used to encourage the development of authentic personal values through articulation (ACPA, 2008; Forum for the Future, 2004; Jucker, 2002; Orr, 2004). Arbuthnott (2009) adds that instruction should include topics focused on behavioral change, including feedback on behavior, specific ways to take alternative action, and incentives that support for behavioral change.

Modeling Reality

ESD also advocates for the close association of educational experience to reality (Forum for the Future, 2004; Hopkinson, Hughes, & Layer, 2008). Strategies for this approach include the use of language for and inclusion of personal experience (Camill, 2002; Howard, 2008; Hulbert, Schaefer, Wacey, & Wheeler,1997; Jucker, 2004; Rode & Michelsen, 2008; Warburton, 2003; Welsh & Murray, 2003), involvement of local and global industry partners (Forum for the Future, 2004; Welsh & Murray, 2003), case study instruction (Camill, 2002), campus participation as a practice community (Everett, 2008; Calder & Clugston, 2003; Hopkinson et al., 2008; Svanström et al., 2008), and contact with nature (Jucker, 2004; Orr, 2004). Focusing on reality acknowledges that we are the problem and empowers learners to direct their own learning, better understanding the impact of their lifestyle, and how to take practical action to support sustainability (Filho, et al., 2009; Jucker 2004; Rode & Michelsen, 2008; Svanström et al., 2008).

The ESD Educator

It is widely accepted in the literature that implementing ESD will remain impossible without the commitment by educators to the new paradigm. This point is less strategic and more a cautionary tale. The literature clearly indicates that the ESD educator is a facilitator, collaborator, and fellow learner on the journey toward sustainability, learner in tow. This educator allows the learner to direct their own learning and guide course content, although this does not necessarily indicate relinquished control or authority. Additionally, the ESD educator must practice what they preach, encouraging values development by example, a position more compelling to the learner (Jucker 2002; Jucker, 2004; Kevany, 2007; Mulder, 2009; Wals & Jickling, 2002; Welsh & Murray, 2003).

Scott (2009) clarifies that the effectiveness of ESD can only be measured by what learners learn, rather than what they evidence partisan support for. In other words, educators would be wise to focus their efforts on *ESD as learning*, rather than *ESD as an indoctrination* of canned behaviors. For example, fostering the ability to think and solve complex problems should trump the promotion of recycling. Mulder (2009) agrees and submits that this may very well require professors, whose research roles demand clearly supported arguments, to develop new competences that encourage learners to build their own contentions, thus learning to discern on their own.

Authentic Assessment

Finally, the development of assessment methods for ESD remains a substantial area of opportunity (Forum for the Future, 2004; Rode & Michelsen, 2008; Svanström et al., 2008; Venkataraman, 2009). UNESCO (2005) makes audible the need for assessments that not only pay attention to knowledge competency, but skills, perceptions, behaviors, and values. Specifically, standardized testing is dissuaded, while methods that speak to a holistic view of the overall quality of education are encouraged. Subsequently, the literature evidences a propensity for authentic assessments through a more qualitative and creative approach. In a review of

assessment methods used in case studies implementing teaching methodologies supportive of ESD, the most common approaches used include iterative instructor-student assessment (Landorf et al., 2008), reflective surveys, peer review (Eagan, et al., 2002), reflective portfolios (Kelly & Fetherston, 2008), reflective journals (Gulwadi, 2007), cognitive maps (Lourdel, Gondra, Laforest, Debray, & Broadhag, 2007; Segalàs, Ferrer-Balas, & Mulder, 2008), in-depth interviews (Ellis & Weekes, 2008; de Eyto, Mahon, Hadfield, & Hutchings, 2008), exams and discussions (Cervantes, 2007), and pre-post tests (Segalàs et al., 2008). Standardized methods of assessment are conspicuously absent from the literature and though some quantitative methods have been used, these are rarely the exclusive method of evaluation.

Most recently, Rode & Michelsen (2008) published a set of indicators for ESD, citing the need to assess changes in attitude and motivation, understanding of the principles of SD, skills and competencies, and overall performance enhancement. The authors suggest using standardized methods to gauge attitude and motivation, while using student feedback and mutual observation of classroom practice to assess the other indicators. Rode & Michelsen (2008) argue that, ideally, the addition of quantitative measurement coupled with qualitative assessment should be the goal. Nevertheless, what is pronounced in this discussion is that *what* we define and measure as excellence in education and *how* we go about determining its achievement is reconceptualized in the transition to ESD (Jucker, 2002).

Clear in the preceding discussion about ESD is a call for transformational change in the explicit (i.e. reframing knowledge) as well as the implicit (i.e. ESD educator) curriculum. But, admittedly, the six themes do not entirely make the channel for such transformation definitive. Fortunately, ESD has hardly reinvented the wheel, but has instead been built upon the educational foundation that came before it. One does not have to travel too far into pedagogical history to find commonalities in former movements that may strengthen the practical implementation of the current movement, such as the Progressive Era of Education (PEE). It is argued here that due to the symbiotic relationship between the ESD and PEE movements, closer investigation of the latter may very well better inform the former; specifically, PEE's use of constructivist pedagogy, which may be enhanced by a dialectical perspective of constructivism for ESD. Most importantly, this investigation may unpack a treasure trove of time-honored practical pedagogical strategies that have been written about for over 80 years, an important resource for educators desiring to implement ESD.

The Progressive Era of Education

Historically, there have been three primary focal points in curriculum: Subject-centered, society-centered, and individual-centered. Traditionalists in education advocate for a subject-centered curriculum in which the subject matter largely dictates its content. Central in this approach is efficiency, subject mastery, and a view of students as future subject experts. It is fair to say that this view, with few exceptions, has dominated the American educational system. This approach to education was called into question after the 1929 stock market crash and the subsequent economic crisis. The PEE emerged with a new paradigm for education, with democracy as its tradition. Proponents of both society-centered and individual-centered curricula advocated a greater influence in education for improving overall quality of life and a healthy democracy. Chiefly, the movement emphasized concern for personal health and community life and pedagogy that embraced emerging psychological and social science understanding of that time (Ellis, Cogan, & Howey, 1986; Marsh & Willis, 2007; Pinar, Reynolds, Slattery, & Taubman, 1995).

Championing PEE was John Dewey, who was actually an individual-centered curriculum enthusiast; although he advocated for greater inclusion and balance of all three curriculum focal points (Marsh & Willis, 2007). Dewey recognized a distinct shift in societal progress at the turn of the twentieth century. Advancements in industry had catapulted society on many levels, inspiring what Dewey felt was an undue emphasis on manual training in education. He was increasingly uncomfortable with industrialization as the mark of social progress and its influence on educational priorities. Accordingly, he signaled a need for education to better serve social progress; progress marked by quality of life. He felt that education should model democratic society, reflective of the world in which learners actually lived (Dewey, 1913). To be clear, Dewey did not believe education should stimulate social change as much as it should foster understanding, values, and capacities among students that could ignite a passion to partake in such change (Pinar et al., 1995).

Consequently, the tenets of PEE included individual- and activity-centered curriculum emphasizing real world problem solving that was guided by a teacher in concert with the learner's own determination. Education was perceived *as* life itself, rather than an anticipation of it. A highly interactive and cooperative learning environment with an open exchange of ideas characterized the classroom, a model of democracy. Unsurprisingly, the social science curriculum dominated with a particularly interdisciplinary flare (Ellis et al., 1986).

One of the products of the movement was The Eight-Year Study. The Eight-Year Study was a comprehensive experiment in progressive education in secondary schools. A partnership with over 300 universities to waive college entrance requirements supported the experiment that followed students from nearly 30 secondary schools into college. Progressive curricula was carefully planned and implemented in these schools. The major findings of the study discovered that students from these schools were far from disadvantaged when it came to meeting college entrance requirements. The study also demonstrated that students fared better both academically in college as well as in life in general (Marsh & Willis, 2007; Pinar et al., 1995). Most surprisingly, students of lower socio-economic status were among those with the highest achievements (Pinar et al., 1995). However, the findings of the study were short-lived and soon gathered dust in the face of World War II and the Soviet launch of the Sputnik satellite in 1957. These developments spurred the return to subject-centered curriculum, chiefly that of science and technology, in an effort to be more globally competitive (Marsh & Willis, 2007; Pinar et al., 1995). With the exception of a reemergence of PEE in the 1960's during the Reconceptualization of Education when the bureaucracy and subject-centered nature of education once again came under fire during the civil rights movement and opposition to the Vietnam War, the movement has receded (Pinar et al., 1995) . . . until now.

The resemblance of the *current* financial crisis, the subsequent criticism of the economic nature of education, and the demand for its reorientation to the events leading to PEE is uncanny. The ESD movement could easily be characterized as another chapter in PEE. A central philosophy to both movements is a healthy democracy. Likewise, both bristle at the industrial model of education. Both favor decentralization and greater responsiveness to local and cultural contexts. Pedagogically, both take an education-*as*-life approach to school, preparing the learner for a quality life in the community, at home, and at work. Both have taken a process over product approach to education, emphasizing the *how* as much as the *what*. Other commonalities include multiple perspectives, cooperation, interdisciplinarity, and real world problem-solving over subject mastery. Lastly, both share the belief that the teacher is a collaborator and facilitator more than the authority. It could be argued that ESD even extends PEE with concepts like

systems thinking and future-mindedness, as Reid (2002) has suggested as a possibility. Thus, as practical action for the implementation of ESD has been deplete, an exploration of the pedagogical underpinnings of PEE may better inform practical implementation of ESD.

Constructivism

Many of the aforementioned pedagogical theories associated with ESD could be easily argued as indicative of a revival of PEE, embodying a constructivist epistemology. These theories are characterized by high levels of learner engagement (active, applied, service & experiential learning), social interaction (problem-based, inquiry-based, & participatory learning), and, most importantly, a metamorphosis of the learner's beliefs (deep learning, transformational learning, emancipatory pedagogy & critical pedagogy). Therefore, constructivism, a supposition about the nature of knowledge and how individuals arrive at that knowledge, may inform pedagogical implementation for ESD (Simpson, 2002).

Extending both behavioral (stimulus-response) and cognitive (internal process) theories about learning, constructivism includes contextual issues, like social interaction as well as previous knowledge and experience, in the construction of knowledge (Tobias, 2009). In this light, knowledge does not reside only in the mind but is situated in the context of an individual's past experience, beliefs, and values, their cognitive process, and their environment (Schunk, 2008). It is no accident that the popularity of constructivism followed PEE, as constructivist teaching methodologies were a signature of that movement (Terhart, 2003). The core assumption of constructivism is that learners actively create their own knowledge, versus acquiring it, and truth is an evolving premise (Confrey, 1990; Fox, 2001; Schunk, 2008; Simpson, 2002). This active engagement is thought to yield a deeper understanding that may be transferred to new and different situations (Fosnot, 1996; Pressley, Harris, & Marks, 1992; Schwartz, Lindgren, & Lewis, 2009; Tobias, 2009).

There are innumerable theoretical positions which underpin constructivism (Bickhard, 1997; Geelan, 1997; Phillips, 1995). One especially comprehensive illustration is that of Phillips' (1995) work in which three continuums are suggested : 1) "individual psychology versus public discipline," 2) "humans the creators versus nature the instructor," and 3) "organic versus deliberate construction" (p. 7). The latter two continuums debate whether humans actively construct knowledge or passively discover it as nature imposes its lessons and whether knowledge construction is naturally acquired over time or is intentionally developed. But, it is the former continuum that is one of the most popular debated in the literature (Cobb, 1996; Geelan, 1997) and the most critical to the current discussion; the central debate being the extent to which the environment or internal processes contribute to new learning. As this debate about the influence of what may or may not happen in the educational environment is most conducive to understanding educational practice, an exploration of perspectives along this continuum are considerably instructive for the purpose of identifying practical action for implementation of ESD.

Constructivism: A Continuum of Perspectives

Three primary perspectives are found along this continuum, individual psychology or public discipline (Phillips, 1995): Exogenous, endogenous, and dialectical. Moshman (1982) describes these three positions in terms of root metaphor, pointing to where the knowledge is constructed: Organism (endogenous or internal construction), mechanism (exogenous or external construction), or contextual (dialectical or interactive construction between organism and mechanism). It will be argued here that it is the dialectical perspective, perched centrally on the

continuum, which may provide the most sound epistemology for ESD, as it is most characterized by social interaction.

Endogenous constructivism

Endogenous constructivism emphasizes internal cognitive processes, new knowledge being dependent on previously developed mental structures. Thus, internal cognitive processes do not imitate the environment, but are simply sparked by experience in the environment (Brooks & Brooks, 1999; Moshman, 1982; Phillips, 1995; Piaget, 1970; Schunk, 2008). This perspective has been primarily shaped by Jean Piaget's theory of cognitive development (Tuckman, 1992). Piaget believed that development is constrained by both genetics as well as structure in the environment. Knowledge creation, therefore, is closely associated to actions and operations taken by the individual in the situations encountered. Central to Piaget's theory was the development of schemata, the conduit of which are assimilation and accommodation, two poles toggled between in the process of adaptation to constraints experienced in the environment (Piaget, 1970). In short, humans encounter situations in their environment that cause them to construct contradictions to what they do and think, throwing them off balance (Fosnot, 1996). To this disequilibrium, they may assimilate by using previously developed schemata to handle a problem for which they are already familiar or accommodate by creating new schemata to handle new and unfamiliar situations (Phillips, 1969; Piaget, 1970; Tuckman, 1992). Termed equilibration, Piaget believed this disequilibrium to be the chief motivator for the development of breadth and complexity of schemata, otherwise known as intelligence (Brooks & Brooks, 1999; Phillips, 1969; Piaget, 1970; Tuckman, 1992).

This perspective connotes a highly active learning environment in which learners are able to explore and experiment through a variety of activities that motivate them to assimilate and accommodate (Piaget, 1970; Tuckman, 1992; Wadsworth, 1978). The classroom is active with problem-solving experiments, rather than dominated by direct instruction (Pressley, 1992; Tuckman, 1992; Wadsworth, 1978). Teachers are discouraged from interjecting outcomes for the learner before they are able to invent on their own, taking a peripheral role until foundational discoveries are firmly grasped (Piaget, 1970; Pressley et al., 1992; Wadsworth, 1978). Thus, the teacher's role is to create an environment suitable for such discovery. Likewise, peer interaction is an important mechanism for moving the learner away from egocentrism (Wadsworth, 1978).

Exogenous Constructivism

Exogenous constructivism emphasizes the influence of the external world on the construction of knowledge, such as instruction, experience, and the use of models in the learning environment (Moshman, 1982; Phillips, 1995; Schunk, 2008). From this perspective, the learner continuously adapts to, not copies, the structure in the environment for which the path of this accommodation is largely unpredictable and is responsive to contextual issues. This perspective has been chiefly influenced by Albert Bandura's social cognitive theory (Moshman, 1982; Schunk, 2008). Bandura was primarily interested by what influenced social behavior. Extending the stimulus-response model of personality development as well as imitation as learning, Bandura sought to articulate *how* individuals go about internalizing values, attitudes, and behaviors in their social culture and the ways in which people attempt to control events in their lives with their thoughts and actions (Bandura, 1977; Grusec, 1992).

Contributing to the exogenous perspective of constructivism substantially are two primary assumptions of Bandura's theory. One, interactions between the learner's cognition and other personal factors (like biology, self efficacy, self-regulation), their environment, and their

behavior are reciprocal; termed triadic reciprocal determinism or reciprocal causation (Bandura, 1977; Bandura, 1989; Grusec, 1992; Schunk, 2008). During learning, the social environment and its modeling processes may be especially impressionistic, while at others, the learner's internal processes take the lead. Thus, the learner and their environment determine each other. The conduit in this symbiotic relationship is cognition and other mediating factors, like developmental status, the perceived authority and competence of models, consequences of the models, the learner's expectations, goals, and self-efficacy (Bandura, 1977; Bandura, 1989; Schunk, 2008; Tudge & Winterhoff, 1993). Where Piaget perceived cognitive conflict to be the primary mechanism for learning, Bandura credits maturation, experience, and, chiefly, the contribution of models in the social environment (Bandura, 1989; Grusec, 1992; Tudge & Winterhoff, 1993). Two, learning may occur enactively or vicariously, rather than as a result of feedback on behavior. Meaning, learning may occur by observing models, live or static. These models convey both thinking and behavioral information about a wide variety of experiences, some of which may be outside the learner's possible range of experience, while others may save the learner from experiencing potential negative consequences of certain behaviors (Bandura, 1977; Bandura, 1989; Grusec, 1992; Schunk, 2008). Bandura drew attention to observational learning, not as a passive process of mindless imitation of models, but as a cognitive process that comes alive during observation (Bandura, 1989; Tudge & Winterhoff, 1993).

What an exogenous perspective implies for the learning environment is that considerable modeling and explanation by the teacher are more common. The learner does not duplicate these models or explanations, but adapts to them using their own context. The role of the teacher and her expert strategies are prominent (Pressley et al., 1992). Bandura (1989) advocated for highly knowledgeable and efficacious teachers who are able to motivate while also developing important cognitive abilities among learners, and especially championed for individualized instruction responsive to learners' developmental needs. Though Bandura was less concerned with whether models should be experts or peers, he does distinguish that as learners get older, the role of an expert model is more and more influential, as domains of interest becomes more specialized (Bandura, 1989).

To summarize, an endogenous perspective of constructivism seeks to explain cognition, the learning environment a place for discovery thought fundamental to developing cognitive structures to aid future learning; while an exogenous perspective seeks to explain behavior, the learning environment emphasizing the use of impressionistic models that the learner may adapt to and make their own.

Dialectical Constructivism

Dialectical constructivism is positioned centrally between these perspectives, emphasizing the contextual nature of the construction of knowledge. From a dialectical perspective, these two poles act in a symbiotic and reciprocal way (Moshman, 1982). Mental contradictions occur during interactions with others, and knowledge is constructed to quiet the disequilibrium created by contradictions that arise in the interactions, similar to Piaget's theory. Though the new knowledge is often a betterment of what was conceptualized before, and undoubtedly better than what the individual could have constructed without social influences, the newly constructed knowledge is context-laden, never fixed, and always vulnerable to amendments (Cobb, 1996; Liu & Mathews, 2005; Moshman, 1982). More importantly, learner constructions are beholden to the communities in which they interact, rather than their cognitive structures alone (Cobb, 1996); social influences are not considered to live *outside* the individual, but are a part of them inherently (Tudge & Winterhoff, 1993). This departs slightly from

Bandura's reciprocal determinism, in which models are considered outside the learner, pressing in on them.

A foremost influence underpinning this perspective is Lev Vygotsky's socio-cultural theory of higher mental processes. Vygotsky's theory de-bunked the idea that humans are like animals, their reflexes engrained, as demonstrated by Pavlov's work with dogs. Vygotsky argued that humans, on the other hand, had the agency to alter their environment (Schunk, 2008). He introduced the idea that the interaction between social activity and internal processes best explained consciousness (Kozulin, 1986; Schunk, 2008). He conceptualized consciousness as the ability to perceive in a meaningful way; ability thought to develop intuitively with social interaction playing a pivotal role. Higher mental processes, therefore, are developed by greater and greater honed perceptions, which are most always shifting and are concerned more with the ability to see beyond the current horizon and less concerned about knowing absolute truth. Thus, Vygotsky saw the two poles of the constructivist continuum as inseparable, *the mind being part of the social group itself*, knowledge being created collectively rather than through individual mental functioning alone. Thus, one person's development influences the other; one person's development *depends* on the other (Kozulin, 1986; Liu & Mathews, 2005; Tudge & Winterhoff, 1993).

In sum, an individual's cultural development is thought to begin first through social interaction, and then internally, with development lagging behind learning (Kozulin, 1986; Liu & Mathews, 2005), as opposed to Piaget who argued development came first. Liu & Matthews (2005) refer to Vygotsky's theory as a historical-dialectical-monist philosophy—historical in that one's development of language and mental functioning are a product of their cultural development, dialectic in that the development is non-linear and few hard, fast rules apply to it, and monist in that humans are interdependent, the byproduct of their reciprocal relationship. The authors explain, "The monist view enables one to go beyond the boundaries set by dualism [seeing the polar ends as separate], and to see how man and world, mind and reality can become the source of growth for each other" (p. 397).

Another fundamental contribution to this perspective of constructivism was Vygotsky's (1978) zone of proximal development (ZPD) (p. 84), which is the difference between where the learner is developmentally and where the learner could be developmentally with the aid of a guide or collaboration with peers. What the learner cannot do without assistance today should be what they can do on their own tomorrow. The implication for education is to design experiences that are matched complementarily to the development of the learner and to design experiences that encourage the learner to pursue activities that go just beyond their capabilities (Vygotsky, 1978).

Vygotsky suggested two types of concepts that learners construct during this experience: Psuedoconcepts (everyday concepts naturally developed by the learner) and scientific concepts (originating from instruction). The psuedoconcepts constructed by the learner must have developed enough to be able to absorb the scientific concept that is being introduced. Fosnot (1996) explains that as the scientific concepts are impressed onto the learner by the instructor, the learner's psuedoconcepts evolve upward to meet the scientific concept. The ZPD is where the two meet. This reciprocity generates a more culturally acceptable conception. Meanings derived are inherently cultural, and, when these new meanings are subjected once again to the cultural environment of the learner, they may be transformed upon reflection (Fosnot, 1996). The ZPD is a pivotal consideration from a dialectical perspective in the classroom, which may include reciprocal teaching strategies, with the teacher as skillful expert in which the learning experience

is crafted to guide the learner's misconceptions or preconceptions to firmer principles or alternatives. Rather than being consistently forthright with feedback, the teacher acts in symbioses with the learner's response, providing feedback as needed to keep the learner firmly planted in the ZPD (Pressley, 1992).

Dialectical Constructivism and ESD

The pedagogical predilections of ESD are considerably oriented to a constructivist epistemology, but it will be argued here that this orientation favors an exogenous, and especially a dialectical perspective, rather than an endogenous one. The attention paid to learner's interaction with the *social* environment is prominent in the ESD literature, with less emphasis placed on internal processes alone. The intonation of lived experience, community, active engagement and collaboration in ESD strategies assert the belief that there is magic in social interaction—with peers, with the instructor, with industry partners. Indeed, the preference for the ESD educator to play the role of collaborator and facilitator rather than authoritarian is indicative of a priority set for interactions between the learners and instructor. Likewise, the emphasis on interdisciplinary or multidisciplinary educational experiences also indicate that there is something distinct brought about by exposing the learner to different social configurations.

From an exogenous point of view, the influence of the social environment dominates, a position not entirely advocated by ESD. For instance, in Bandura's theory, though the reciprocity of interactions between personal factors, behavior, and the environment are undeniably akin to Vygotsky's reciprocal interactions, Bandura emphasizes observational learning over experiential, a key point of departure from ESD proponents. Pedagogies like service, participatory, and experiential learning are characterized by collective inquiry and problem solving that require learners to dialogue with others around them, discovering new meanings collectively in flight. Wals (2010) argues that learning strategies that emphasize dialogue and cooperative experiences are useful for ESD as they promote pluralism and the marriage of prior perceptions with new meaning. Indeed, the dialectical perspective is especially responsive to the complex, uncertain, and values-laden nature of sustainability (Bonnett, 2003), a concept ripe for both experiential opportunities and dialogue that may exhibit mismatches between preconceived notions and a more appropriate worldview. Sustainability is also fundamentally dynamic, in which the truth with a capital T, in many cases, is a moving target. Thus, working together with a more knowledgeable expert, trying on their expert frameworks and conceptual processes may better hone perceptions and expand alternatives. Likewise, learners may easily become overwhelmed by all that sustainability encompasses, in which the ZPD is a novel tool for keeping the learner engaged with the topic, while also being responsive to where they are at present. Lastly, both a dialectical perspective of constructivism and ESD champion for iterative reflection, supporting Vygotsky's contention that social interaction precedes internal reflective processes, reinforcing cognitive development and learning that happens post-interaction.

Constructivism in the Classroom

As many theoretical positions underpin constructivism, so there are instructional strategies (Schwartz et al., 2009). It is important to reiterate that constructivism is an epistemology, an idea about the nature of knowledge and how it is constructed. It does not necessarily translate to a theory about teaching, but instead has *implications* for teaching (Fosnot, 1996). These implications accentuate real experience, exploration of multiple perspectives, holistic instruction of broad concepts, and social interaction (Schunk, 2008). Following is an overview of constructivist teaching strategies, accompanied by some strategies supportive of a

dialectical perspective. The reader is encouraged to capitalize on the wide and deep body of literature regarding these teaching methodologies that may be used for the implementation of ESD.

From a constructivist point of view, subject matter must be made personally relevant to the learner, allowing an opportunity for personal meaning making. Chiefly, subject matter should not be presented in a fragmented, isolated fashion that demands memorization and regurgitation, but should instead present the learner with an over-arching problem and the major concepts that punctuate it (Brooks & Brooks, 1999; Terhart, 2003). Consequently, course content is rarely concrete (Terhart, 2003). For example, a constructivist teacher may present one major question, expose learners to a collection of resources to help them answer it, then allow time for learners to explore what they think, share their propositions with others, and allow their hypotheses to be criticized (Brooks & Brooks, 1999; Hodson & Hodson, 1998). Similarly, subject matter must emphasize multiple perspectives, relying less on a prescribed set of information to disseminate uniformly to learners and more on the use of various perspectives of learners themselves (Brooks & Brooks, 1999). Evidencing variability in a topic is important to assisting learners in understanding how their learning may apply to new and different situations (Brooks & Brooks, 1999; Fosnot, 1996). A notable byproduct of this approach is that the resources used to assist learners on their journey are less likely to be textbooks and more likely to be primary data or supplemental materials (Brooks & Brooks, 1999).

By emphasizing multiple perspectives, the suppositions of learners are challenged, creating an opportunity for confirmation or contradiction of beliefs (Brooks & Brooks, 1999; Fosnot, 1996) and an opportunity to learn discernment (Schartz et al., 2009). Learners must also be given license to raise their own questions and test hypotheses (Fosnot, 1996). In this atmosphere, learners are allowed to follow their own inclinations, reconstruct what they know, and arrive at an uncommon knowing that is inclusive of many different perspectives on truth. Learners must also be allotted time for reflection (Confrey, 1990; Fosnot, 1996) and time to pay attention to their own thinking and learning process (Terhart, 2003). This process takes time, more time than traditional didactic methods (Brooks & Brooks, 1999; Millar, 1989), something the constructivist teacher must be cognizant of. Teachers must resist the temptation to cover a broad range of material rather than honor the human process necessary to reach a deep of understanding necessary for transfer to other contexts (Confrey, 1990; Fosnot, 1996). Efficiency may be regained in the long-term, as a teacher who allows learners time to explore and invent on the front end may glean more efficient ways of going about activities as a result; while if efficiency is demanded too early, learners may prematurely adopt rote mechanisms rather than authentic processes (Schwartz et al., 2009).

Brooks and Brooks (1999) describe the constructivist teacher as "a weaver, an explorer, and an analyst" (p. 98) and one "who helps search rather than follow" (p. 102). All require the ability to intuit flexibly through the learning process with learners, a highly challenging but rewarding endeavor (Schunk, 2008; Confrey, 1990). The teacher is not the keeper and disseminator of finite truths, but social interaction is the conduit for constructing truths, interaction between teachers and learners, and learners and their peers (Schunk, 2008; Terhart, 2003). Closely related, teachers must be interested, receptive, and responsive to unforeseen responses and *how* those ideas are constructed (Confrey, 1990), as meaningful shifts in suppositions will prove impossible until teachers fully understand the learner's experience and conceptual processes that contribute to their current conceptions (von Glasersfeld, 1996). Summarily, suppositions can only be challenged if the curriculum is complimentarily matched to

the learner's current abilities, which is primarily ascertained through interactive experience (Brooks & Brooks, 1999; Confrey, 1990).

Finally, assessment is tightly married to the educational experience, rather than a measurement separated from that experience. Rather than measuring effectiveness or accountability singularly, assessment is another learning opportunity for the learner, an authentic assessment (Brooks & Brooks, 1999; Schwartz et al., 2009). Here, assessment is mediated by the teacher and may include observations of reciprocal interaction with the learner or the learner with their peers. Other forms of authentic assessment may include creative projects, like exhibits or portfolios (Brooks & Brooks, 1999). Evaluating students only for the correctness of their answers is counterintuitive to a constructivist approach; assessment is rather a demonstration of progress. Key in this discussion is that the evaluation *serves the learner* in some way and does not simply measure what is known by them (Brooks and Brooks, 1999; Schwartz et al., 2009; Terhart, 2003), going beyond retention to transfer (Schwartz et al., 2009).

Dialectical Constructivism in the Classroom

Discussed so far are some of the most basic tenets of constructivist teaching which may prove useful for the implementation of ESD. The constructivist continuum exhibits varying emphases in both type and degree of assistance given to the learner and the type of knowledge that is constructed (Moshman, 1982). For example, from an endogenous perspective, the teacher is there to guide the discovery the learner makes through activities. In an exogenous perspective, the teacher is more apt to model, discuss, and explain. In a dialectical classroom, a reciprocal teaching style is more common, always mindful of the ZPD. It is this latter approach, which may be the most useful in teaching sustainability related content. Hodson & Hodson (1998) contend this is a most challenging task for the teacher, described as *educational enculturation*:

> Vygotskian theory gives teachers a central role: leading children and students to new levels of conceptual understanding by interacting and talking with them. Thus, teaching comprises the activities associated with enabling the learner to participate effectively in the activities of the more expert, and learning is seen as *enculturation* via guided and modeled participation. Expert performance is modeled and learners are instructed and supported in their effort to replicate expert practice . . . over time, through assisted performance, the novices master all the component parts and gradually become capable of full and autonomous participation . . . responsibility is gradually transferred from expert to (the former) novice until such time as the student is intellectually independent and no longer needs the teacher (p. 37).

Vygotsky (1978) did not perceive education as society's passive impression onto the learner. Rather, education should thrust the learner beyond their own history and culture. Most importantly, he emphasized that learning is by virtue not uniform, never to be reduced to a set of skills and habits, but is a highly complex intellectual order that makes transfer to other situations possible. In this environment, action is prominent for the teacher, the learner, and the environment. Though Vygotsky emphasized the role of experts, he also paid particular attention to peer collaboration. Indeed, all influence the development of the other.

Pressley et al. (1992) compare dialectical constructivism to strategy instruction, a process, similarly described by Vygotsky, which includes a knowledgeable expert and the gradual adoption of the expert's strategies by the student. Exact replication of the expert's methods is not realistic or desired. Instead, the learner makes the expert's methods their own,

evidencing a deep understanding and the ability to generalize to other situations. Pressley et al. (1992) offer eight ingredients of strategy instruction thought to align with dialectical constructivist teaching:

1. Strategies are introduced in a graduated fashion, typically demonstrating interrelationship with other strategies
2. Strategies are practiced across a variety of tasks
3. Teachers model strategies coordinated with verbal explanations in collaboration with learners
4. Teachers justify the values of strategies or rationale and draw the learner's attention to how they might affect their own performance or achievement
5. Considerable feedback and discussion are offered throughout strategy practice, responsive to arising challenges in the learner's experience
6. Opportunities for transfer to new and different situations are acknowledged
7. Motivation is maintained by the teacher, empowering learners to take control of their own development
8. The process of planning and reflection in problem solving trump the completion of tasks

The primary distinction made by Pressley et al. (1992) between strategy instruction and dialectical instruction is that of the explicitness of feedback, which is far more intensive in strategy instruction. A dialectical constructivist teacher is more prone to give feedback proportional to what keeps the learner in the ZPD. In other words, the teacher is keenly attuned to where the learner is and feedback is given just beyond the learner's current level of knowledge, motivating them to construct more. This is thought to keep the internal dialogue and reflection inside the learner afloat. Feedback given too early may cause boredom; given too late, the learner may become overwhelmed and frustrated. Essential to this approach is the use of scaffolding. In sum, dialectical constructivist teachers promote the path of discovery via careful guidance in learning, asserting that deep learning and a greater ability to transfer that learning to other scenarios resul

ESD Theme	**Constructivist Strategy**	**Dialectical Strategy**
Reframing knowledge Use of sustainability lens Breadth over fragmentation Focus on problems Emphasis of sustainability triad Include sustainability literacy Use of consistent language	1. Introduce emerging problem which learner finds personally relevant 2. Explore multiple perspectives of problem (may use sustainability triad) 3. Use primary data or supplemental readings that focus on problem & various solutions to it 4. Frequently illustrate relationship between discipline-specific principles & principles of sustainability during problem-solving	1. Carefully scaffold introduction of sustainability concepts, responsive to learner's current level of development 2. Encourage action & application of concept 3. Then, observe learner to detect confusion or confidence during action & application 4. Interact with learner in reciprocal fashion, providing feedback loops, pushing learner beyond current understanding of sustainability (assisting learner in navigating complexity)
Developing skills Working with others Communication Systems thinking Creative & imaginative problem-solving Ethical or values-focused thinking Future-mindedness Research skills Reflection Transfer	1. Present a question related to sustainability to investigate (such as a problem impacting the future of the field) 2. Encourage dialogue, research, & exploration of question in peer groups 3. Require learner to reflect on investigative experience, encouraging introspection of impact of experience on personal values 4. Upon reflection, ask learner to raise their own questions & propose new hypotheses to investigate	1. Present a question related to sustainability to investigate 2. Encourage dialogue, research, & exploration in peer groups 3. Have expert (instructor or outside partners) interact with learners frequently during investigation & provide iterative feedback 4. Require learner to reflect on investigative experience 5. Offer expert feedback on that reflection, pushing learner once again beyond current level of development
Developing values Articulation of values Focus on behavioral change		

ESD Theme	**Constructivist Strategy**	**Dialectical Strategy**
Reality modeling Focus on real problems Use personal experience Use local/global industry partners Case study Campus as model community	1. Introduce emerging problem that affects learner on their campus 2. Explore multiple perspectives of problem in peer groups (may use sustainability triad or focus on stakeholder perspectives) 3. Require interaction with real stakeholders involved in the problem 4. Use primary data or supplemental readings that focus on problem & various solutions to it 5. Frequently illustrate relationship between discipline-specific principles & principles of sustainability during problem-solving	1. Carefully scaffold introduction of an emerging problem that affects learner on their campus, responsive to learner's current level of development 2. Require interaction with real stakeholders involved in the problem 3. Require learner to partner with expert (instructor or industry partner) to explore problem & potential solutions 4. Frequently, observe learner to detect confusion or confidence during problem solving 5. Interact with learner in reciprocal fashion, providing feedback loops, pushing learner beyond current understanding of the problem (assisting learner in navigating complexity)
The ESD educator Facilitator-collaborator Fellow learner Practice what you preach Encourage learner to develop autonomous contentions	1. Instructor frequently invites learner to explore a problem *with* them 2. Instructor draws out learner perspectives & encourages learner to designate the path by which to explore the problem 3. Instructor provides resources & other support responsive to the learner's chosen path of exploration, remaining flexible to travel unplanned avenues 4. Instructor shares personal experience & models important processes related to problem & encourages learner to make autonomous decisions	1. Instructor (expert) frequently invites learner to explore a problem *with* them that is responsive to the learner's current level of development 2. Instructor (expert) models conceptual processes related to the problem & shares personal experience with problem 3. Learner takes action & applies concepts themselves, trying on the expert's conceptual framework 4. Instructor (expert) observes to detect confusion or confidence during action & application 5. Instructor (expert) provides frequent feedback responsive to the learner's confusion or confidence 6. Learner is encouraged to reflect on this experience & make autonomous decisions
Authentic assessment Process *and* produce are measured	1. Comprehensive semester project embodying multiple facets of sustainability is assigned to which all course modules relate 2. *Process* of completing project is incentivized, including the application of skills related to working with others & critical thinking during course work 3. Learner is encouraged to pay attention to the learning process & demonstrate their progress in final project	

Synthesis

In Table 1 and Table 2, the previously discussed themes of ESD are summarized, including some specific attributes of each theme. Additionally, some specific examples of deliverable applications are offered in constructivist terms generally and then from a dialectical perspective, providing an illustration of how these pedagogical approaches may be used to implement ESD. These examples illustrate how the constructs of the constructivist epistemology discussed here could be applied to a sustainability context to deliver the desired outcomes articulated by the ESD movement.

For example, the ESD themes Reframing Knowledge and Reality Modeling may be delivered with the use of constructivist approaches like focusing on emerging problems, emphasizing broad concepts, and using supplemental materials. By introducing learners to emerging problems related to sustainability, particularly problems that are personally relevant to the learner, like how their own field impacts sustainability, the tenets of sustainability are permitted to transform discipline-specific content. When the learner is encouraged to explore, for example, environmental, social, *and* economic perspectives on a discipline-specific problem, the concrete limits that are often imposed in standardized curriculum design are cast off. Instead, a broad interdisciplinary or multidisciplinary approach is invited. Often, textbooks are ill-equipped to facilitate this type of learning, thus, the incorporation of supplemental resources, which may include primary data or other readings, are utilized to support the learner's problem-solving. Throughout the problem-solving adventure, the instructor aids the learner in illustrating the interrelationships between the discipline and sustainability.

Extending this approach from a dialectical standpoint would include careful scaffolding of course content to insure the learner is not overwhelmed by the complexity of sustainability. Learners often arrive at sustainability-related topics with widely varied understanding. Thus, a dialectical approach emphasizes the need to introduce only enough information to set the learner upon a course of action. Once the learner is in motion, attempting to apply the learned concept, the instructor observes, watching for confusion or confidence. When either is detected, the instructor (the expert) begins to interact with the learner in a reciprocal way, dialoguing, then offering feedback, and sometimes, more resources. Whatever the case, what is given is directly responsive to pushing the learner just beyond their current position of development. This feedback is, of course, tailored to the individual learner in the moment, carefully managing potential frustration, guiding the learner through the complexity. Further, the learner is permitted to try on the expert's framework during interaction, until the learner can become more autonomous and make their own contentions about sustainability.

Likewise, the constructivist and dialectical strategies illustrated for skills and values development which emphasize collaborative, interactive, and experiential investigation as well as the use of reflective writings. Reflection prompts the learner to pay attention to the learning journey, developing new questions and hypotheses that may, once again, receive another wave of feedback. Reflection also allows the learner to use their personal experience with sustainability issues to shape their personal values and better articulate what is now important to them, in light of their recent experience. These investigative experiences with sustainability may be further enhanced with a dialectical perspective, which would encourage greater interaction with a variety

of stakeholders or experts, beyond the instructor, perhaps those involved in the sustainability issue. All the while, the learner's skills and values are shaped by their experience in this learning community where they must frequently interact, explore, communicate, argue, persuade, invent, reflect, and apply *with* others.

Other points that merit discussion are that of the ESD Educator and Authentic Assessment. Constructivism gives definition to the ESD Educator by utilizing a strategy such as asking the learner to investigate a sustainability issue *with* them. This removes the instructor from an all-knowing authoritarian role, something arguably inconceivable when it comes to sustainability. Instead, the instructor is positioned *beside* the student as they learn *together*. This position is extended by a dialectical perspective in that the instructor is often more experienced and more knowledgeable and openly shares this with the learner, *when they are developmentally ready to receive it*. This approach is not necessarily a one-to-one interaction, but may include the instructor interacting similarly with a peer group. Drawing out student interests about sustainability, another constructivist strategy, empowers the learner to designate their own learning path. This requires a lot of flexibility on the part of the educator, but there is a payoff in engagement. Allowing a learner to choose what they want to learn about sustainability, what they want to investigate, what they are curious about, increases the learner's investment in sustainability.

Finally, ESD's preference for authentic assessment is, again, given greater life by the use of constructivist approaches. One of the chief challenges in the industrial model of education is what the system chooses to reward: outcomes or products. From a constructivist standpoint, the journey is its own reward. But on the average course syllabus, this is rarely the case. Thus, taking a constructivist approach encourages us to identify creative ways to incentivize the journey; for example, weighting grades in a manner that offers incentives for both applying the ESD-related skills during course work as well as the completion of course work itself. In this case, the learner would be required to demonstrate their *progress* made in qualitative terms and not only the product created.

Arguably, these approaches challenge the industrial model of education, focused on manual training and efficiency. These approaches take time and require a level of social interaction that may be complicated by lecture hall style formats designed to educate the most with the least resources. Particularly, the delivery of some dialectical strategies require much iterative interaction and feedback, something that is demanding both on time as well as the skill level of the instructor. However, the potential payoff of delivering graduates who are better prepared to engage with those around them to solve sustainability issues represents a substantial return on investment.

Final Thoughts

The preceding discussion correlates the ESD and PEE movements for the purpose of expanding support for pedagogical practice for ESD with the use of constructivism, but especially dialectical constructivism. Notably, as practical direction for the implementation of ESD has been deplete, this discussion draws attention to constructivist strategies, encouraging educators to capitalize on these existing ideas which align with ESD philosophy. Educators working to make ESD a more pronounced part of their pedagogical repertoire may find this work helpful, as it removes some of the mystery associated with ESD implementation.

Chiefly, these time-honored pedagogical approaches put real skin on the potential dissolution of the industrial model of education, something the ESD movement advocates. These approaches reflect a substantial shift away from manual training of discipline-specific content to a focus on enhancing quality of life; a quality of life that is rich with intellectual as well as social capital, a currency that may be transferred to a variety of situations: work, home, and community. Preparing the learner to work in industry may very well be supported, but is no longer an end in itself. Rather, capacity-building, values development, and cooperative relationships are fostered in the educational environment, couched in local contexts that are real rather than abstract to the learner. According to Vygotsky (1978), learning is enhanced when knowledge is created together through interaction, the product of which is better than that which is created alone. Thus, learners should be encouraged to be interdependent upon one another to continuously amend the truth with greater and greater precision, inviting emergent outcomes. Is this not what the sustainability journey is all about?

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