

Implementing Active Learning to Enhance Student Knowledge on Environmental Sustainability

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Abstract

Environmental sustainability becomes increasingly important in a world of finite natural resources. In this context, the role of business education is to develop students' appreciation for the role of business in society and help students to understand the responsibility of businesses in environmental protection and sustainable development of economy. Therefore, there is a need to provide various opportunities for student to develop knowledge and skills in problem solving, communication, computation, critical thinking, and decision making regarding environmental sustainability. The goal of this study is to assess business student learning on environmental sustainability by implementing active learning. Active learning is to give students more opportunities to meet the educational goals of classroom, connect classroom learning to its application in the business world, and increase student engagement in problem solving and decision making. Pre/post-tests were conducted in traditional business courses to evaluate effectiveness of active learning in environmental sustainability. The results indicate that students' knowledge on environmental sustainability improved significantly through implementation of active learning.

Keywords: Environmental Sustainability, Active Learning, Student Learning, Assessment

1. Introduction

Environmental sustainability is defined as responsible interactions of human being with the environment to avoid depletion or degradation of natural resources and allow for long-term environmental quality (Callicott & Mumford, 1997). It includes the creation and maintenance of good environmental conditions and best practices to manage resources more efficiently and effectively through the development of green products and services, use of reusable materials, effective waste handling services, and recycling innovations. From the business standpoint, environmental sustainability requires that current businesses consider the long-term impact of their activities for the benefit of future generations. It requires lesser energy and resources consumption and waste, moving toward sustainable environment. Despite the fact that some companies have fully embraced the concept of corporate environmental responsibility, environmental conditions are still worsen (Derevenskaia, 2014).

To respond to the concerns for environmental problems, universities across the world have played a crucial role in addressing key issues of environmental sustainability (Burns, 2011, 2013). Integrating environmental sustainability into education system and curricula could offer both educators and students the opportunity to promote sustainability because it may influence their worldviews and attitudes towards environmental sustainability. Sustainability has been integrated into universities' mission and values, strategic planning, curricula, research, student life, operation and purchasing, and community partnership (Hiller Connell & Kozar, 2012).

Teaching of sustainability in business schools has emerged as an important field, and within this field business educators have shown great interest in innovative teaching methods to facilitate the understanding of environmental sustainability in business environment (Cervantes, 2007; Stough et al., 2018; Stubbs & Cocklin, 2008). As students are the future corporate leaders, business schools help shape the attitudes and behaviors of students through classroom activities, undergraduate research programs, real-world projects, and extra curricula activities. Researchers suggest that universities should incorporate environmental sustainability into traditional business courses to enhance students' awareness of current situation of environmental threats and their social responsibilities as the future leader (Cervantes, 2007).

Remington-Doucette et al. (2013) indicate that sustainability education might be most effective if infused into traditional business courses. Incorporating environmental sustainability in traditional courses typically focuses on critically examining information about the myriad of problems that exist, and exploring possible solutions to these problems (Burns, 2011, 2013; Shephard, 2008). Scholars argue that current education methods are not sufficient for teaching sustainability because of the complexity and deeply challenging nature (Burns, 2011, 2013). They emphasize that the key to successfully teaching of environmental sustainability is to make the study interesting and relevant to students (Cervantes, 2007). They maintain that classroom interactions are critical for sustainability teaching where both students and instructors actively interact with each other. Students become active participants in learning process, instead of passive listeners (Derevenskaia, 2014). This paper addresses this issue and explores how to enhance student learning on environmental sustainability through active learning in traditional business courses.

The paper is structured as follows. Section 2 is a review of literature of active learning. In section 3, pre/post-tests were designed and conducted to assess effectiveness of student learning on environmental sustainability via active learning. Active learning is based on student learning goals about environmental sustainability and the outcome is enhanced student achievement. Section 4 is an analysis of pre/post-tests about student awareness of environmental sustainability. The emphasis is on how to improve student performance through active learning practices. Section 5 is conclusion and discussions.

2. Active Learning

Active learning is defined as a teaching method that addresses students' active participation in their own learning (Anderson & Adams, 1992; Chickering & Gamson, 1987). Compared to passive learning, where the main players are educators who design and deliver instruction completely, active learning is a student-centered inductive learning process (Chickering & Gamson, 1987; Stokes, 2012). In active learning, students are active in their learning through self-motivated activities of information gathering, independent thinking, and problem solving (Michael, 2006). Sivarajah et al. (2019) summarized four benefits of active learning: (1) improved student attention, (2) enhanced higher order learning, (3) more motivation, and (4) highly developed professional skills. In traditional passive listening environment, students mainly learn by remembering and understanding, and are weak at practical skills for professional work such as team skills, communication, negotiation, and peer assessment of performance (Chickering & Gamson, 1987; Michael, 2006; Sivarajah et al., 2019). In active learning, students acquire higher order skills of theoretical application, problem identification, and decision making to real-world challenges (Chickering & Gamson, 1987).

Active learning has been widely applied in classroom teaching since it enhances student understanding and retention of knowledge (Anderson & Adams, 1992; Chickering & Gamson, 1987; Nicol & Macfarlane-Dick, 2006). With active learning, students study with clear purposes and are engaged in learning proactively in diverse environment. Active learning requires students to do meaningful learning activities and think about what they are doing (Anderson & Adams, 1992). By participating in active learning, students engage in a deeper level of thinking and acquire the skills needed to be a life-long learner. Bennette (2011) and Wood (1987) pointed out that active learning is a process of eliciting understandings from students and using them to enhance student achievement. It involves gathering and interpreting information from students and then taking actions to improve identified weak areas (Ruiz-Primo & Furtak, 2004, 2007). Student's problem solving ability improves under the guidance and support of instructors (Wood, 1987). The instructor and students interact and collaborate during the learning process to reduce the gap between desired and observed student performance (Boud & Molly, 2013; Ruiz-Primo & Furtak, 2004, 2007).

2.1. Traditional Passive Learning

Traditional passive learning is an instructor-centered teaching environment where learning is highly structured and allows the instructor to have more control. It is a planned activity designed to gather information about student understanding. In traditional classroom lecturing, the instructor facilitates and the students are passive listeners. Characteristics of traditional learning are: (1) instructor talks and students listen, (2) communication among students is discouraged, (3) students have less opportunities to respond to instructors' questions, (4) students' understanding of course materials is not monitored explicitly, (5) instructors have less opportunities to correct misunderstanding of students, and (6) students have less interest in long lecture (Cox & Rogers, 2005). Students' main activities such as tests and assignments are pre-designed or selected in advance by the instructor so that students' work can be collected based on schedule. In passive lecturing mode, instructors can present a large amount of material very efficiently (Michel et al., 2009). However, traditional learning is not actively involving students and scholars call for an innovative learning environment in which students' initiative and creativity are ensured (Chickering & Gamson, 1987).

2.2. Comparison of Traditional Passive Learning and Active Learning

Michel et al. (2009) and Ruiz-Primo and Furtak (2004, 2007) identified the differences between traditional passive learning and active learning. In passive learning, the instructor gathers information at a planned time, takes time to analyze the information, and takes actions to improve the problematic areas. In active learning, the instructor acquires information during learning and immediately uses the information to address the concerns of students. Michel et al. (2009) reported that students fail to retain as much material after lecture has been completed in comparison to classes taught in an active environment. Don (2017) compared traditional learning and active learning in college lower division courses and found that students retain 70% of information in the first 10 minutes of lecture, and after the first 20 minutes, student attention drops off significantly. Figure 1 is adopted from Don (2017) which compares traditional learning and active learning setting.

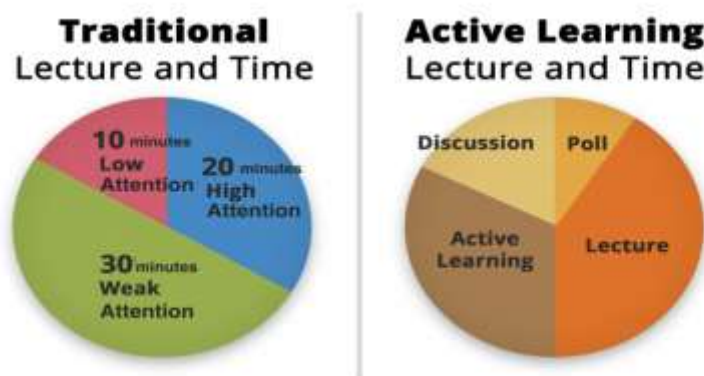


Figure 1: Comparison of Traditional and Active Learning Setting
(Adopted from Don, 2017)

After an extensive research, Helerea et al. (2008) argued that the role of instructor is essential in both traditional and active learning. They recommended that the traditional and active methods could be combined to take advantages of strengths of both learning modes. Table 1 is adopted from Helerea et al. (2008) and provides a comparison of traditional and active learning.

Table 1: Comparison of Traditional and Active Learning

Traditional Learning	Active Learning
Lectures	Work in tutorial
Knowledge transfer	Building the knowledge
Syllabi	Defining the objectives
Theory and concepts	Conflict-situations/problems
Knowledge acquisition	Skill to learn
Deductive thinking	Inductive thinking
Memorizing lectures	Finding the information
Individual work	Group work
Exams	Self-assessment/formative evaluation

Note: adopted from Helerea et al., 2008

Both traditional and active learning techniques highlight the knowledge acquisition. Traditional learning focuses on knowledge transfer, while active learning emphasizes knowledge building by students themselves. Passive learning requires students to learn class concepts and theories, while active learning involves the application of theories to solve real-world problems. Traditional learning uses standardized assignments such as quizzes or midterm tests to determine student learning and progress. Active learning on the other hand involves more interactions between (1) instructor and the students, (2) students and students, and (3) students and real-world business professionals (Ruiz-Primo, 2011). Although active learning is an important technique to improve student learning, it is not a simple replacement of traditional lecturing technique. Education literature suggests the combination of traditional and active learning strategies to improve teaching effectiveness and enhance student learning (Helerea et al., 2008; Ruiz-Primo & Furtak, 2004, 2007)

3. Pre-Post Tests of Student Knowledge on Environmental Sustainability

3.1. Instrument of Environmental Sustainability Knowledge

Environmental sustainability is a very broad concept with diverse perspectives from different scholars. Previous studies have identified important environmental sustainability issues in college education. Wright (2002) reviewed definitions and frameworks in higher education and identifies emerging themes and priorities of environmental sustainability in different universities. Abraham (2006) designed a pollution prevention hierarchy including source reduction, reuse or recycle, energy recovery, waste treatment, and secure disposal. Abraham (2006), Watson et al., (2013), and Watson et al. (2017) designed a rubric to assess student knowledge and ability to engage in environmental sustainability. Their concerns include improving natural ecosystems, using life cycle thinking to all activities, implementing environmental sustainability management system, minimizing natural resource depletion, preventing waste, protecting natural ecosystems, using renewable energy sources, using inherently safe and benign materials, developing clean products and technology, replenishing depleted resources, lowering materials and energy consumption, designing green packaging, and developing green supply chain and clean production. Based a review of previous research, this study summarizes environmental sustainability issues into seven categories:

1. Climate change: addressing global warming, emissions, acid rain, and ozone depletion.
2. Resource efficiency: addressing clean production, eco-efficiency, and protection of natural ecosystems.
3. Clean products and services: developing clean products and technology, green supply chain, and green packaging.
4. Resource use: addressing depletion and conservation of materials, energy, and water, and reduce materials and energy consumption.
5. Alternative energy: addressing alternative and renewable energy and technology.
6. Policy and administration: addressing government and company policies and management system that enforce environmental sustainability.
7. Waste management: waste reuse and recycling.

Multiple choice questions were designed to address knowledge of environmental sustainability on the above seven areas. These questions were used in pre-tests for measuring students' initial level of knowledge on environmental sustainability. To determine the effectiveness of active learning, the same test was used at the end of semester to measure students' achieved level of environmental knowledge.

3.2. Pre/Post-Tests of Student Learning on Environmental Sustainability

Population of the study consisted of three traditional business courses with total of 116 students. The subjects took a pre-test to determine their actual level of knowledge on environmental sustainability at the beginning of semester. The students then experienced active learning during the semester about the environmental sustainability. The instructor used different strategies of active learning in the semester including open-end class discussions, real-world case analyses, group work/discussions, group teaching, short essays, reading quizzes, turn-and-talks to neighbors, peer reviews, note sharing, demonstrations, manager interviews, real-world projects, etc. The same subjects took the same tests at the end of semester to assess their achievement. The time interval between two tests was 15 weeks. This is long enough to minimize the effect of the pre-test on the results of study.

4. Results of Pre/Post-Tests

The pre-test was administered at the beginning of semester and the post test was conducted at the end semester. The results of two tests are summarized in Table 2. In the tests, student awareness is assessed on a scale of 0 to 100 (100 being the highest). In Table 2, the pre/post testing results are compared and paired t-tests are conducted to analyze the differences between the two tests on the seven areas of environmental sustainability.

Table 2: Pre/Post Tests Results

Sustainability Issues	Pre-Test n=116	Post-Test n=116	Difference Pre/Post Tests*
Climate change	81.10	92.46	11.36
Resource efficiency	41.83	74.34	32.51
Clean products and services	36.45	70.16	33.71
Resource use	62.31	76.37	14.06
Alternative energy	56.92	84.56	27.64
policy and administration	30.87	61.49	30.62
Waste management	72.38	82.77	10.39

Note: sample size n=116; scale 0-100; * indicates all significant at $p < 0.01$.

The results show that students understand issues of the climate change and alternative energy very well. Pre-test scores of climate change is 81.10 and that of waste management is 72.38. Results reveal that climate change and waste management are closely related to our health and daily life and have received intense media coverage. Students already have good knowledge on waste disposal, recycling, and global warming. Previous studies showed that average American generates about 4.4 pounds of waste per day, and the average recycling rate is only about 30%. Solving environmental problems requires long-term plan and actions for the sustainable development of economy.

The results also show that the weak areas are knowledge related to policy and administration, clean products and services, and resource efficiency, with pre-test scores of 30.87, 36.45, and 41.83 respectively. Developing renewable energy is one of the most efficient and effective solutions to environmental threat. Based on the assessment results, the instructor should make plans to address the weak areas such as issues related to clean products development, green packaging, green supply chain, and environmental policies and administration. It is noticeable to find that, overall, scores of post-test at the end of the semester are higher than those of pre-test during the semester. The differences between scores of pre/post-tests range from 10.39 to 32.51 and are all significant at $p < 0.01$ on seven environmental issues.

5. Conclusion

In this study, active learning is implemented in traditional business courses to incorporate environmental sustainability in curricula to enhance student awareness on environmental crisis. Literature on sustainability education and active learning is reviewed and integrated to frame the research. Important environmental sustainability issues are reviewed and used to form student learning goals related to environmental sustainability. Pre/post-tests are conducted and analyzed to evaluate student learning on environmental sustainability.

The results demonstrate that active learning is effective in enhancing student engagement and learning, which is able to improve student achievement and attitude toward environmental sustainability. This study shows that active learning can be incorporated purposefully into single assignments or into small changes to a course over time to support important learning goals. Active learning can be applied to traditional course activities if we involve the students as active participants in learning.

Finally, there are challenges in applying active learning in teaching such as lacking of time, pressure in studying, as well as separation of theoretical and practical studies (Niemi, 2002). Bonwell and Sutherland (1996) identified five major barriers to implementing active learning in classroom such as (1) the “coverage” problem, (2) increased class preparation time, (3) large classes, (4) limited, or lack of, resources and support, and (5) the risks of colleagues’ disapproval and student dissatisfaction (Stokes, 2012). Further, environmental sustainability requires the engagement of all stakeholders including customers, employees, communities, universities, educators, students, governments, etc. Therefore, it is necessary for business faculty to develop a comprehensive plan to ensure that all aspects of environmental sustainability are addressed in different university programs (Krizek et al, 2012).

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