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IMPACT OF SOCIAL MEDIA AS AN INSTRUCTIONAL COMPONENT
ON CONTENT KNOWLEDGE, ATTITUDES, AND PUBLIC ENGAGEMENT
RELATED TO GLOBAL CLIMATE CHANGE

BY

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DISSERTATION

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ABSTRACT

Social media (SM) are considered important avenues to reach citizens and engage them in social change. Given the widespread use of SM and their potential to enhance communication, they could also have significant influence when used as an educational tool. Educators are exploring whether classroom SM use has instructional benefits, such as enhancing interactivity and engagement. It is critical to understand the potential of SM for creating meaningful learning environments and public engagement pathways. Much work remains to understand the use of SM in this context and how to use them effectively.

This study draws on active learning theory to examine the impact of SM as an instructional component with community college students learning to make connections among science, social responsibility, and global understanding in an environmental biology course (the Course). Using global climate change as a theme, the Course included a Facebook instructional component. A pretest–posttest, nonrandomized comparison group design was used to measure the impact of Facebook as an integrated component of the Course. The treatment and comparison groups were determined to be comparable based on demographics, access and ownership of digital devices, and SM use despite non-random assignment. No statistically significant differences were found between groups on these factors. The intervention consisted of semester-long required use of Facebook for the treatment group. The impact of the SM intervention was measured in three areas: (a) content knowledge, (b) attitudes toward climate change, and (c) public engagement actions and intentions to act.

At the conclusion of the Course, no discernable difference was measured in content knowledge gains between the two groups. However, students who used Facebook experienced statistically significant differences in attitude, becoming increasingly concerned about global

climate change. The comparison group demonstrated statistically significant differences in attitudes shifting toward more disengaged. Students who used Facebook showed considerably greater tendency toward action and expressed more intention to act than those who did not.

Treatment group participants self-reported in interviews that the learning environment was enhanced in four areas: (a) convenience and logistics, (b) community and communication, (c) engaging learning environment, and (d) alternative participation pathways. Comments classified under the theme convenience and logistics provided insight into how the instructor and participants used Facebook in the intervention, such as to post maps and discuss assignment details. Comments categorized under the theme community and communication were those that made explicit who used Facebook and the impact of the intervention on communication and classroom community in areas such as creating dialog, carrying the discussion beyond the classroom, and having access to the instructor. Responses categorized under the theme engaging learning environment provided specific details about how Facebook use affected participants' engagement in the learning environment, such as their contribution to the course content and increased interaction with the course content. Comments within the alternative participation pathways theme showed ways in which Facebook use facilitated the other three themes, including removing barriers for shy students, providing additional time for issues that arose during class discussions, and through passive participation by reading the posts of classmates.

This empirical study demonstrated that the use of Facebook in an educational setting had an impact on student attitudes and engagement actions. Additionally, Facebook use enhanced the learning environment in meaningful ways showing that SM, when used intentionally, benefits active learning environments and provides an opportunity to enhance a sense of public engagement among college students.

In Memoriam
Chao-Li “Jack” Liu

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CHAPTER 1

THE PROBLEM

Introduction

Humankind faces no greater challenge than the changing global climate and its potential impact on societies throughout the world. The scientific evidence is conclusive. According to a report issued by the Intergovernmental Panel on Climate Change (IPCC) in 2007, “warming of the climate system is unequivocal” (p. 30). The years between 1995 and 2006 were among the warmest recorded, sea level has risen yearly since 1961, and the concentration of carbon dioxide (CO₂) in the atmosphere is significantly higher than the natural range over the last 650,000 years (IPCC, 2007). It is the emission of greenhouse gases, such as CO₂, into the atmosphere from the burning of fossil fuels and industrial practices since 1750 that are the major anthropogenic drivers of the observed changes in the global climate (IPCC, 2007). According to current models, a 50% reduction in greenhouse gas emissions from 2005 levels is needed to slow the global climate changes already in progress (International Energy Agency [IEA], 2009). Experts believe the decade from 2010 to 2020 is a critical juncture in the path toward achieving this daunting goal by 2050 (IEA, 2009). Meeting these challenges requires immediate social, political, and economic action.

Addressing monumental environmental challenges, such as global climate change, demands that citizens be knowledgeable and prepared to work toward meaningful solutions. Indeed, as globalization increasingly diminishes borders and creates cultural and economic interdependence, the environmental problems that affect us on a global level often necessitate taking action at the local level. It raises questions such as, “How do we address the challenge of

improving the quality of life around the world while balancing environmental quality?” and “How do we encourage and empower citizens to be willing to consider global benefits and willing to take local actions to address our greatest environmental challenges?”

Assuming that members of the global society can agree that humankind benefits from achieving a balance among natural resource use, environmental impact, and the best available lifestyle for the most global citizens, we must start somewhere to build a culture of environmental responsibility. To meet these objectives, we must first create a dialog among scientists, resource users, and interested publics based on analysis of the full impact of human activity on environmental systems (Dietz, Ostrom, & Stern, 2003). This approach assumes an informed, empowered, and responsible public willing and prepared to engage in addressing complex environmental issues. Starting early to teach these ideals is an important educational approach to building such civically engaged individuals. Interestingly, these same qualities are recognized as essential for the development of the intentional learners necessary to address societies’ greatest challenges in the 21st Century (Ramaley & Leskes, 2002). Intentional learners, according to Ramaley and Leskes (2002), are empowered through intellectual and practical skills. They are informed, through inquiry, about the natural and social worlds. Additionally, intentional learners are responsible for their personal actions and for civic values.

The question then becomes one of how can we facilitate and teach students to become intentional learners that are empowered, informed, and responsible in ways that are meaningful and accessible? Young adults (18 to 29 years of age) studying the environment and global climate change are in need of just this set of characteristics and pathways to make connections between what they know and what they are willing to put into action. Finding educational means by which to develop these experiences are needed. This study examines one such approach by

exploring the use of SM in an active learning setting for potential impacts on student learning, attitude, and as a mechanism for facilitating engagement and action.

Background and Rationale

To address increasingly complex issues, such as global climate change, viable solutions must be found that accommodate multiple social, political, and economic objectives. Viewpoints about global climate change are by no means uniform and have changed considerably over time becoming more concerned (Bardaglio & Putman, 2009). Since 2006, increasing consensus and clarity have driven the international policy discussion toward adaptation and mitigation strategies.

Even though progress has been made, the challenge is compounded by variance in personal, cultural, and political attitudes and practices. For example, in the United States the public remains divided along political party lines in its concern and beliefs about global climate change (McCright & Dunlap, 2011). Despite the increasingly convincing data on and research into technological solutions, debates regarding the human contributions to climate change, or even whether climate change is real, continue to rage in the United States (Kitcher, 2010). Individuals are bombarded with conflicting views presented as balanced journalism (Boykoff & Boykoff, 2004). Indeed, political campaign rhetoric gives voters the impression that the role of greenhouse gas emissions can be either believed or dismissed (Kitcher, 2010; Malka, Krosnick, & Langer, 2009), while scientific and technological mitigation strategies, which seek to balance energy and environmental needs, are often met with skepticism and concern. By contrast, environmental organizations and environmentally minded individuals actively oppose further use of fossil fuels for power, industry, and transportation.

Governments, research institutions, and private-sector stakeholders face increasing challenges concerning how best to educate, communicate with, and engage the public to gain

acceptance for technical approaches that attempt to balance the economic virtues of continued use of fossil fuel resources with environmental concerns over the continued, unchecked emissions of CO₂ into the atmosphere (Nisbet, 2009). However, changing strongly held stakeholder perceptions and entrenched positions is difficult, if not impossible (Leiserowitz, Maibach, Roser-Renouf, & Smith, 2010). Interested stakeholders, regardless of their side in the climate change dialogue, argue for transparent communication and community engagement through information delivery, education, discussions of risk, feedback mechanisms, and ensuring that citizens have a voice in the process (Herbertson, Ballesteros, Goodland, & Munilla, 2009; Hund & Judd, 2008).

Public Engagement and Education

To have a lasting impact in mitigating global climate change, significant and long-term changes need to be made, with policies that begin now and last long into the future. This necessitates preparing members of the younger generation to address the environmental issues they will inherit. Education can provide a foundation for young adults to become informed, empowered, and responsibly engaged citizens by creating active learning environments in which individuals gain knowledge and experience.

Active learning environments that are focused on teaching environmental science and sustainability can provide engagement models that will carry beyond the classroom into their everyday life (Bardaglio & Putman, 2009). Such learning opportunities may have an impact with young adults because these students are at an age when they are beginning to make decisions about how they want to live their lives, what their environmental interests and orientations are, and how they will engage with the world.

Education plays a significant role in preparing young adults for long-term challenges through active learning settings that address global socioeconomic and environmental issues such as global climate change. Creating pathways of engagement for young adults in these learning environments is a challenge that needs to be met. Finding solutions to the mounting environmental challenges requires that young adults become engaged and have pathways for communicating about and making informed decisions about policy, technology, and personal actions. By teaching young adults to engage in issues that concern them, social capital can be created as they are forming their adult identity, thereby helping guide them to bridge the gap between ideals and actionable solutions while raising their level of engagement (Valenzuela, Park, & Kee, 2009).

However, active engagement does not necessarily develop without guidance and practice, and youth may need to be taught how to participate in civically and politically meaningful ways (Bennet, 2008). This raises the question of how to prepare and train young adults to take on roles of public responsibility, to weigh personal and societal factors when making decisions, and to stay engaged when problems are difficult or overwhelming (Hudson, 2001). One pathway to teaching engagement may be learning environments where public engagement activities and skills are developed as a function of the environmental education process (Hudson, 2001).

Ways to model meaningful engagement that also generate communication and contribute to involvement are needed and may be facilitated by using popular technologies and tools in the classroom that students already use for communicating and social engagement (Hill, 2012; Valenzuela et al., 2009)

Public Engagement Through Social Media

Public engagement is a process that involves providing opportunities for members of the general public to have a voice in decision making, mutual learning, and two-directional communication between the public and experts, rather than the traditional one-directional communication from experts to the public (McCallie et al., 2009). Although the importance of public engagement is recognized, creating meaningful engagement opportunities can be challenging because public knowledge levels, attitudes, and willingness to act vary.

The unprecedented connectivity that electronic devices and SM provide may be a key to teaching these objectives in an educational setting. Because of the accessibility and increasing popularity of SM, they are one potential mechanism for encouraging or facilitating public engagement, especially among young adults who use SM as part of their everyday communication (Rheingold, 2008). Social media communication platforms, such as Facebook, Twitter, and blogging, are increasingly relied on to facilitate conversation and interactivity among social networks (Boyd & Ellison, 2007; Huberman, Romero, & Wu, 2009; Lenhart, Purcell, Smith, & Zickuhr, 2010; Madden, 2010; Taylor, Kent, & White, 2001). People use SM to connect with and through their social networks to retrieve and pass information, express opinions, and demonstrate beliefs and values. In fact, SM are often used to maintain connections and create new online communities (Haythornthwaite, 2007b, Haythornthwaite & Hagar, 2005; Kaplan & Haenlin, 2010).

Social media use is clearly on the rise and is increasingly considered an expected form of communication among young adults (Lenhart et al., 2010). For example, in 2010, 86% of young adult Internet users used social networking sites (Lenhart et al., 2010; Madden, 2010). As the availability of and access to SM increase, the potential for interactivity and participation have

increased (Lenhart et al., 2010; Madden, 2010). One advantage of using SM is the ability to reach people and pass information quickly by tapping into existing social networks. The ubiquitous use and access to digital devices also contribute to the potential for using SM as a mechanism for educational engagement. Furthermore, the public nature of SM allows for considerable transparency in discussions around environmental issues on local and global scales.

Social Media Research

Social media are defined as “a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0 that allow the creation and exchange of user-generated content (Kaplan & Haenlin, 2010, p. 61). *Web 2.0*, a term coined in 2004, is used to describe new ways software developers and users began to utilize the World Wide Web. Web 2.0 is considered the next generation of ways in which the Internet can be used, in which users and developers participate in the creation of digital content and applications, which includes the expectation of collaboration and participation in the process of information development and delivery (Anderson, 2007; Kaplan & Haenlin, 2010; O’Reilly, 2005; Tredinnick, 2006). Web 2.0 can be considered the platform upon which SM sits and user-generated content as the way people use SM to communicate (Kaplan & Haenlin, 2010).

Educators, SM users, and content providers are still exploring how to use these media to achieve far-reaching information delivery while creating the potential for new interactivity and engagement. However, given the widespread use of SM and its potential to maximize communication resources and strategies, SM could be significant if used as both a communication and an educational tool. Much work is still needed to understand how to use SM effectively in active learning. Potential alone is not enough to guarantee that young adult users would engage effectively either in the classroom or with issues when using SM in active learning

settings. Therefore, to create meaningful learning environments and public engagement pathways, it is critical to understand the possibilities of SM use before deploying it. Assessment of the impacts of SM use in engaging learners beyond the obvious social functions is needed.

To date, SM research has primarily addressed the sociological implications of SM use. Research has been focused in five domains: (a) inequality and the digital divide, (b) community and social capital, (c) political participation, (d) organizations and economic institutions, and (d) cultural participation and cultural diversity (DiMaggio, Hargittai, Neuman, & Robinson, 2001; Hargittai, 2003). Additionally, work has been undertaken to understand how, in what ways, and for what purposes young adults use SM.

The use of SM in education is the subject of much speculation and is believed to hold great promise for communicating with students in the digital age (Bennet, 2008; Oblinger & Oblinger, 2005; Rheingold, 2008), but very little empirical work has been undertaken on the efficacy of using SM to engage students in a learning environment. Additionally, SM may have considerable potential to facilitate student engagement in political and environmental issues while also enhancing their engagement in the classroom and their awareness of community. Such is the focus of the present study.

Theoretical Framework

This study draws on active learning theory to examine SM as a mechanism for engaging community college students. Because SM are used by individuals to connect with their social networks to obtain and pass information, express opinions, and air beliefs and values, they may also prove useful in the creation of educational and public engagement experiences (Boretree & Seltzer, 2009; Donath & Boyd, 2004; Rheingold, 2008; Taylor et al., 2001; Waters, 2007).

Environmental education focuses on real-world issues, which integrate community perspectives and participation. Combined with SM this may provide a platform for active learning in which learner-centered activities can make environmental values explicit and provide a mechanism through which to act on them. The National Research Council believes that effective education takes place when learner-centered, knowledge-centered, and formative assessment dimensions overlap (Bransford, Brown, & Cocking, 2000). Building on constructivist theories of the 1990s, Land and Hannafin (2000) characterized active learning environments as favoring authentic learning contexts, student-centered goal-directed inquiry, and personal perspectives. Technology within the active learning environment is viewed as a tool that can be used to scaffold student-centered learning tasks (Land & Hannafin, 2000).

Further, SM may be an important tool to enhance engagement within learner-centered environments because such environments consider student background and pay “careful attention to the knowledge, skills, attitudes, and beliefs that learners bring to the educational setting,” (Bransford et al., 2000, p. 133). Participation and the creation of content are valued on SM, which, when used in meaningful educational settings, may act as a bridge among content, the instructor, and the student to explore new ways of engaging. Active learning theory also encourages critical thinking and open-ended activities, learners’ personal responsibility for learning, and instructor-led learning activities that encourage learner exploration, all of which may be created as a function of SM use (Kame, 2004). Social media may also be an active part of the student engagement process, which involves active participation, a cognitive investment, and emotional engagement (Chapman, 2003). Finally, increased student engagement requires intentionally engaging to make connections to real life (Graffam, 2007; Livingstone, Couldry, & Markham, 2007).

Social media may enhance the sense of community in the classroom by adding a component of socialization, which some educators consider beneficial to learning. Community-centered learning environments can help students make connections between what happens inside the classroom and their lives outside, given that “classroom norms can encourage modes of participation that may be unfamiliar to some students” (Bransford et al., 2000, p. 146). Furthermore, community-centered learning environments provide pathways for conversation and other interactions between students and their social networks, and such environments enhance overall learning by helping them make connections outside school (Bransford et al., 2000).

In summary, SM have the potential to enhance the learning environment in many ways by creating more opportunities for knowledge-sharing, learner-centered activities, and scaffolding public engagement. Rheingold (2008) highlights one such example of the potential power of SM in the learning environment by posing the question, “What if teachers could help students discover what they really care about, then show them how to use digital media to learn more and persuade others (p. 99)?” However, potential alone is not enough to ensure the full value of SM is realized (Rheingold, 2008). Social media use in active learning environment must be empirically tested to further determine in what ways they contribute to student learning and engagement.

Purpose and Research Questions

This study examined Facebook as a tool for educational engagement with young adult (18 to 29 years of age) community college students in the domain of environmental science. The environmental biology course (the Course) selected for this study was specifically designed to teach students to make connections among science, social responsibility, and global understanding. Rather than assume students naturally make connections among content,

environmental values, and action, Course instructors explicitly teach about environmental issues, social responsibility, and public engagement. The educational objectives of the Course include goals that seek to “increase scientific literacy related to the environment, and empower more well-informed, active citizens who have the skills to participate in and adapt to their changing world” (Course Instructor, 2007, p. 19).

This study assessed the impact of integrating a SM instructional component into this existing active learning environment in three areas of influence: (a) knowledge, (b) attitude, and (c) action. Specifically, the impacts of Facebook use on student content knowledge, attitudes about global climate change, and public engagement actions or intentions to act were measured. The intervention integrated a Facebook instructional component with the study of environmental issues. An additional Course feature was the use of global climate change as a central theme. The guiding research questions were:

1. What is the impact of an integrated SM component on student content knowledge, attitudes toward global climate change, and indicators of public engagement in an environmental biology course?
2. What is the nature of the student engagement experience when using an integrated SM component in an environmental biology course?

Significance of the Study

The use of SM, especially social network sites, is increasing in the United States. More than 90% of young adults in America (aged 18 to 29 years) use the Internet daily through smartphones, tablets, and computers (Lenhart et al., 2010; Madden, 2010). The far-reaching potential of these media has prompted educators and organizations of all kinds to explore how and when to use SM to reach audiences effectively, especially young adults, who are often at the

forefront of new media trends. Using SM in education may provide a unique bridge for teaching public engagement principles while facilitating active learning at the same time. By understanding the role SM can play in creating active learning environments that model consideration of environmental issues and that teach students the skills to become publicly engaged through communication pathways they already use for social interactions, this research provides insight into how SM can be used to build capacity for engagement among young adults.

Social media hold significant promise because as communication and engagement tools they provide unprecedented access to information and individuals' social networks.

Communication is driven by interactions that tap into the social networks of interested parties, who then communicate more widely within their networks, potentially moving the educational process from the classroom into students' everyday lives (Huberman et al., 2009; Kelleher, 2007). However, to realize this potential, greater understanding of if and how SM use impacts student experiences within active learning settings and as engagement tools is needed. Research on the efficacy of SM in this context becomes critical if the potential for educational use of SM, for example, as an instructional mechanism for public engagement, is to be fully realized. This study provides insight into how SM can be used in active learning environments to open pathways for communication, public engagement, and interaction. Furthermore, this study is an empirical step toward addressing questions of how to use SM in meaningful ways to inform, motivate, and enhance public engagement.

CHAPTER 2

REVIEW OF THE LITERATURE

Introduction

Achieving a balance between energy use and environmental concerns depends on creating shared goals for solving the social, economic, and environmental challenges facing society. Increased public involvement has several benefits for policy makers and citizens alike, namely, facilitation of decision-making, instilling trust in decision-makers, and enhancement of public knowledge (Rowe, Marsh, & Frewer, 2004). Many people know how to act on issues that concern them, and they possess the resources, social capital, and desire to do so. Yet many people, especially young adults, may not know how to engage in public means of problem solving, nor do they feel comfortable doing so. Youth participation in civic and political life is limited (Louder, 2007). Barriers to participation are plentiful and may include a lack of experience, feelings of despair, and disinterest (MTV, 2007). The question regarding how to facilitate engagement among citizens emerges when information about issues, the perceived need for change, and the desire to change are limited (Rowe & Frewer, 2005). If substantial change is to take place, new and engaging ways to facilitate involvement among those not currently interested in addressing global issues must be found.

Current educational trends call for students to become responsible learners that “understand their roles in society and accept active participation” (Ramaley & Leskes, 2002). Thus, it is hoped that students who receive higher education degrees will possess the skills that will increase the likelihood of their being active participants in sociological, environmental, and political issues (Ramaley & Leskes, 2002). Yet, engagement and involvement in environmental

issues does not happen overnight. How do young adults develop their environmental stances and the commitment to act on their ideals? It has been shown that students who participate in service projects in high school are more likely than nonparticipating students to engage in civic activity as adults (Youniss, McLellan, & Yates, 1997). Additionally, civic engagement is significantly influenced by demographic and external factors (Livingstone et al., 2007). However, we may be doing students a disservice by assuming they know how to be active participants (Rheingold, 2008; Hudson, 2001). Students could benefit from having engagement modeled in the classroom and from opportunities to explore and challenge ideas regarding environmental issues through familiar pathways for communicating and engaging.

Engagement in Education

One school of thought for addressing issues like global climate change is to model the changes and values we want young adults to learn. The concept of the intentional learner proposed by Ramaley and Leskes (2002) fits this approach whereby through liberal arts education students are prepared as intentional learners who “are integrative thinkers who can see connections in seemingly disparate information and draw on a wide range of knowledge to make decisions” (p. 22). In this model, intentional learners are empowered through both intellectual and practical skills. Additionally, intentional learners are engaged in active learning and exposed to alternative ways of knowing (Ramaley & Leskes, 2002).

Another approach to this modeling of engagement and responsibility has occurred at the institutional level as institutions of higher education have recognized the need to examine their own environmental impacts and their ability to operate using sustainable practices. In some cases, universities have adopted explicit institutional reforms to create sustainability-based learning environments that prepare students for citizenship and careers in the 21st century (Cortese, 2003;

Jones, Selby, & Sterling, 2010; Sterling, 2001). Proponents of this perspective subscribe to Gandhi's view that they need to be the change they hope to see in the world. Such institutional reformers claim that to affect change in young adults, we must:

Develop a learning environment that fosters students' ability to comprehend the big picture, makes the necessary connections among what are framed as isolated problems, and takes effective action to protect humanity's life support system. Unless we change the climate on campus, we are unlikely to stave off the global climate change that threatens our future. (Bardaglio & Putman, 2009, p. 70)

Institutions of higher education can play a critical role in educating young adults in environmental responsibility and sustainability. Indeed, authors such as Cortese (2003) believe "higher education institutions bear a profound, moral responsibility to increase the awareness, knowledge, skills, and values needed to create a just and sustainable future" (Cortese, 2003, p. 17). Some authors believe a systems approach to sustainability learning is needed that influences the learning context by facilitating the practice of sustainability and making explicit the value of partnerships with the community (Cortese, 2003). An educational context needs to be created that allows students to be "actively engaged in the practice of environmentally sustainable living" and that includes an understanding of the social and ecological impacts, or "footprint," of human activities (Cortese, 2003, p. 19).

Another perspective encountered in the literature claims sustainability education can create participation-oriented students rooted in a reenvisioned, practical liberal arts and sciences education (Bardaglio & Putman, 2009). Participation in these democratic ideals, according to Bardaglio and Putman, requires active engagement: "The most important way we can demonstrate our commitment to active, engaged citizenship is to be effective stewards of our natural, social, and economic resources not only for the current generation but for all future generations" (p. 174). These authors call for a shift from focusing on understanding barriers and

problems to focusing on solution-based thinking. Using case studies from institutions such as Berea College, Ithaca College, and Arizona State University, they provide examples of how universities are implementing concepts of environmental responsibility and sustainability, teaching by example with the hope that such leadership will result in the realization of more sustainable communities. Supporters of this idea suggest that those in higher education should consider the concept of sustainability holistically and see education from a sustainability perspective, and as a participatory process in which learning takes the form of exploration through practice (Rheingold, 2008; Sterling, 2001).

Rheingold (2008) suggested SM may have a role to play in realizing these goals by connecting the current generation of learners and taking advantage of popular participatory communication pathways:

Education could play a pivotal role by equipping today's digital natives with historical knowledge, personal experience, rhetorical skills, and a theoretical framework for understanding the connection between their power to publish online, their power to influence the circumstances of their own lives, and the health of democracy. (Rheingold, 2008, p. 104)

This view clearly recognizes the potential of SM as a vehicle whereby learners can discover their voice and become engaged participants. However, little empirical assessment has been undertaken to demonstrate this, especially in the classroom.

The Net Generation, Millennials, and Digital Natives

One body of literature to emerge in the last ten years attributes characteristics to learners of the current generation based on access to digital technology as a driver for young adult communication and learning styles. Because this new generation of learners entering higher education will ultimately be the citizenry engaged in issues of global climate change long after

the current policy and decision-makers have retired, examining these shared characteristics may provide insights into creating learning environments in which young adults may flourish.

Monikers for this generation include the *Net generation* (Oblinger & Oblinger, 2005), *millennials* (Howe & Strauss, 2000; Zickuhr, 2010), and *digital natives* (Prensky, 2001). Millennials, as defined by the Pew Internet & American Life Project (Pew Research Center, Washington, DC), were born between 1977 and 1992 and were 18 to 33 years of age in 2010. Millennials represent 30% of the adult population and 35% of the Internet-using population (Zickuhr, 2010). Those on the younger end of this group, namely, those born after 1982, are thought to share a unique set of learning characteristics and preferences, stemming in large part from the fact that they have always had the potential for access to computer and digital technologies in their daily lives and are highly social in their activities because of constant electronic connectivity (Dahlstrom, de Boor, Grunwald, & Vockley, 2011; McBride & Nief, 2011; McNeely, 2005; Oblinger & Oblinger, 2005). For example, according to the Beloit College Mindset List, which speculates yearly on shared characteristics among entering freshman classes, digital natives have never dialed a telephone, and they consider *friend* a verb (McBride & Nief, 2011). This study primarily uses the terms *millennials* and *digital natives*, both of which refer to the group of young adults born after 1982 and presumed to have a shared set of characteristics that may drive their educational, social, and political preferences.

Prensky (2001) expanded on the concept of digital natives in pointing out that they “have spent their entire lives surround by and using tools of the digital age” (p. 1). By labeling the current generation digital natives, he distinguishes them from earlier generations who were not born into the digital world but who entered as digital immigrants, retaining an “accent” from their former nondigital culture (Prensky, 2001). He theorizes that the gap between digital natives

and digital immigrants may play a role in education in the coming years because most instructors are digital immigrants, whereas their students are digital natives. Thus, between their expectations of the world and their proficiency in technology, a gap may exist between how digital natives experience the world and how educational institutions prepare them for public engagement.

Bridging the divide between immigrants and natives, according to Prensky (2001), is a fundamental challenge facing education over the next several decades, namely, how to adapt instructional methods and content to reach digital natives and maintain relevancy. In other words, Prensky claims educational institutions must find methods of creating learning opportunities for digital natives by using digital technologies that capitalize on their learning styles and preferences.

Claims abound regarding the group preferences of these young adults, such preferences for group activity, new technologies, and diversity (Oblinger & Oblinger, 2005). Connectivity is an expectation of many in this generation, and researchers have attributed them with holding the views that the Internet is better than television, that doing is more important than knowing, and that multitasking is a way of life. Students own multiple forms of technology to stay connected, such as laptops, smartphones, and tablets (Dahlstrom et al., 2011). It is theorized that digital natives believe it is “cool” to be smart, that science and technology can solve problems, and that they can have an influence on the world (Howe & Strauss, 2000; Oblinger, 2003; Oblinger & Oblinger, 2005). Further shared characteristics attributed to these young people are that they prefer learning by doing, human interaction, connectivity or not working in isolation, and relevancy in education (Brown, 2002; McNeely, 2005). Digital natives, it is said, have a

tendency to work in teams or with peers, move seamlessly between physical and virtual interactions, and prefer participatory learning (Oblinger & Oblinger, 2005).

Because technology plays such a large role in the lives of students inside and outside the classroom, the need arises to examine how it can be incorporated into learning environments to enhance student learning (Clayton-Pedersen & O’Neill, 2005). In one such study, Roberts (2005) used focus groups, interviews, and polls to ascertain how students viewed technology as a tool for learning. Roberts (2005) found that participants defined technology as “any electronically based application or piece of equipment that meets a need for access to information or communication” (p. 3.2). Customization and adaptability were key factors identified in participants’ definitions of technology. How technology was used in the classroom was also cited as an important factor. When further questioned about quality in the learning environment, students reported expectations of expertise and passion from instructors, as well as technology use that fostered the communication of expert knowledge (Roberts, 2005).

The most extreme supporters of the digital native and Net generation characteristics claim that electronic devices and connectivity have caused the brain to function differently and that these students think and process information differently from others (Barnes, Maraeto, & Ferris, 2007; Prensky, 2001). Although no such claims have been substantiated, the potential for differences in learning preferences and patterns experienced by digital natives does bear further consideration.

The body of literature defining digital natives focuses on the appetite modern students have for experiential, interactive, and authentic learning environments. These students use various forms of electronic devices to maintain constant connectivity. Presumably, these two traits can be combined to facilitate engagement in the learning environment while guiding

learning about engaging in environmental issues inside and outside the classroom. Certainly, digital natives place more focus on what technology allows one to do than on specific technologies (Oblinger & Oblinger, 2005; Roberts, 2005). Indeed, if the values attributed to digital natives hold true and they do prefer participatory learning, aligning the learning environment with their preferences by using participatory media and technologies may indeed facilitate learning. However, merely having access to technology is not enough. These learners need relevant and practical uses for technology that build on their constant digital connectivity. Challenges faced in educating digital natives are creating an educational environment in which learning is social, technology use is relevant, and both are effectively integrated into course work (McNeely, 2005).

Current Levels of Participation Among Young Adults

Civic and political participation by young adults may be greatly facilitated by strengthening the engagement pathways already being used. There is no doubt that this population is constantly connected to each other and the world around them through their digital devices. However, it remains to be seen whether young adults who have always used digital media as the primary mode of communication will fully realize the potential of online participation. As Rheingold (2008) pointed out, using Internet media may not solve young adult disengagement from political life; however, such media may be a “powerful tool to be deployed toward helping [students] engage” (p. 99).

Louder (2007) theorized that youth participation, or lack thereof, takes two potential paths, cultural displacement or citizen disaffection. Yet, some studies showed that young adults are looking for ways to participate constructively in societal decisions and need autonomy and agency to mobilize (Louder, 2007; MTV, 2007). In a study conducted by a professional research

company for MTV between 2005 and 2006, youth between the ages of 12 and 24 were surveyed online ($n = 1,187$) and interviewed ($n = 98$) in schools and on college campuses to understand their views on activism and involvement, barriers to action, and participation mechanisms (MTV, 2007). Involved youth (75% of those surveyed) reported being motivated by local or personal issues and were motivated by wanting to help others. Issues to which these youth related, specifically local issues, were given higher ratings of importance, with family members tending to drive youth participation choices. Participants also reported the belief that small personal changes could influence global issues.

Participants surveyed in the MTV study recognized the importance of participation; however, the study revealed a significant gap between interest (70% believed it was important to help the community) and involvement (19% were very involved). The study also identified barriers to involvement, which included lack of interest (18%), lack of time (29%), lack of knowledge (14%), and the desire to see concrete results (8%). From this study, it might be concluded that youth need clear pathways for action and would also benefit from participatory experiences that provide “direction, encouragement, and flexibility” (MTV, 2007, p. 2). Recognizing the need to move from interest to involvement, the researchers recommended targeting areas for participation where youth were already involved. Further, organizations should leverage technology-based social networks in their efforts to engage youth (MTV, 2007).

In a 3-year ethnographic study, Ito et al. (2009) examined youth participation patterns in *networked publics*, a term they used to define “participation in public culture that is supported by online networks” (p. 11). Their study found that youth used online networks to *hang out* with people they knew offline and that connectivity was a high priority.

Ito et al. (2009) characterized three genres of participation in online media, separated by the degree and sophistication of engagement, namely, *hanging out*, *messing around*, and *geeking out*, which varied by the participant's level of interaction with the media. They found that youth were constantly engaged with their peers through a variety of mechanisms, such as SM and text messaging, at one of these three levels. This participation in networked publics, according to Ito et al., opened new avenues for youth to participate through either personal or interest-driven networks. Participation in personal networks was mainly in the form of hanging out and negotiating peer-learning environments, whereas interest-driven networks tended to involve more diverse but intentional knowledge-based networks. The authors suggested there is a role for adults and education in the interest-driven networks. Education, they claimed, could be more than preparation for future careers; it could also serve as a process of guiding participation in public life, including through social, recreational, and civic engagement (Ito et al., 2009).

Participation and Engagement in Social Media

Social media are distinguishable from other types of media in that they promote interaction through social networks and use social networks for information sharing, community building, and engagement (Garton, Haythornthwaite, & Wellman, 1997; Haythornthwaite, 2007a). Social networking sites, a form of SM, “enable users to connect by creating personal information profiles, inviting friends and colleagues to have access to those profiles, and sending e-mails and instant messages” (Kaplan & Haenlin, 2010, p. 63). Personal profiles can and do include various information, such as blogs, videos, photographs, and reposts of content from other places (Kaplan & Haenlin, 2010). Boyd and Ellison (2007) further defined social networking sites as places where users can make their social networks explicit and allow

participants to: (a) construct a public profile, (b) articulate a list shared connections, and (c) navigate their connections and those made by others.

In a classification scheme devised by Kaplan and Haenlin (2010) SM were considered based on two scales of degree of participation and richness of interaction: (a) self-presentation or self-disclosure, and (b) social presence or media richness (Table 1). Social networking sites are considered to have a high degree of self-presentation and a medium degree of media richness.

Table 1

Social Media Classification Scheme

		Media richness		
Social presence	Intensity	Low	Medium	High
Self-presentation	High	Blogs	Social networking sites (e.g., Facebook)	Virtual social worlds (e.g., Second Life)
Self-disclosure	Low	Collaborative projects (e.g., Wikipedia)	Content communities (e.g., YouTube)	Virtual game worlds (e.g., World of Warcraft)

Blankenship (2011) and Rheingold (2008) proposed another approach of looking at SM focused on literacy. According to them, SM included perspective five components of literacy: (a) attention, (b) participation, (c) collaboration, (d) network awareness, and (e) critical consumption. However, they pointed out that the digital literacy needed for engagement is not necessarily inherent and needs to be explicitly modeled (Blankenship, 2011; Rheingold, 2008).

Rheingold (2008) refined the definition of participatory, or social, media to include characteristics present in three realms: (a) technical–structural, (b) psychological–social, and (c) economic–political. Technologically speaking, participatory media result from greater connectivity, removing the structure present in traditional media, which is primarily

unidirectional from broadcaster to audience. Social media derive value and power from participation—the more the better—although Rheingold pointed out “value derives not just from the size of the audience, but from their power to link to each other, to form a public as well as a market” (p. 100). Finally, participatory media amplify communication quality, which allows for “broader, faster, and lower cost coordination of activities” (p.100). The power of participatory media resides within the latent potential for participation (Rheingold, 2008).

Helping students in the 21st century to develop a voice is one way to bridge the desire for involvement with actual engagement. Rheingold went on to say,

By showing students how to use Web-based tools and channels to inform publics, advocate positions, contest claims, and organize action around issues that they truly care about, participatory media education can draw them into positive early experiences with citizenship that could influence their civic behavior throughout their lives. (p. 102)

Indeed, education may help bridge the gap between what students care about and how they express those concerns. It is this “activation gap,” according to Rheingold (2008), that needs to be closed for students to become actively engaged citizens.

Bardaglio and Putman (2009), theorized that education may be advanced by using SM, which may help in breaking down existing boundaries among learning, teaching, and research (Bardaglio & Putman, 2009). Because SM use social networks to build social capital, they may facilitate learning environments that “embrace synergy and synthesis, where [students] are producers as well as consumers of information” (Bardaglio & Putman, 2009, p. 83). Social media use allows for increased student participation in learning environments. According to Bardaglio and Putman (2009), SM hold great promise for transforming education by creating learning environments that encourage student contributions and the generation of content.

Additionally, SM may provide an excellent formative assessment pathway to benefit and engage learners in the learning environment. Formative assessments provide feedback in the

classroom to improve teaching and learning (Bransford et al., 2000). Assessment, according to the National Research Council, “should occur continuously, but not intrusively, as part of instruction” (Bransford et al., 2000, p. 140). Social media may facilitate unobtrusive and continuous formative assessment by providing new feedback pathways and modes of communication within the learning environment (Bransford et al., 2000; Rheingold, 2008).

In an empirical study of online activities in young adults, Livingstone, Couldry, and Markham (2007) examined the connection between young adults’ online activities as a way to invigorate participation in politics. They found that online interactivity and creativity could stimulate participation, but that the civic engagement is significantly influenced by demographic factors. Political activity reflected prior interest and offline activities (Livingstone et al., 2007).

Public Engagement Through Social Media Use

Public engagement provides another framework by which to understand civic activity, information flow, and the participation potential of using SM in active learning. Rowe and Frewer (2005) broadly defined public engagement as “the practice of involving members of the public in the agenda-setting, decision-making, and policy-forming activities of organizations/institutions responsible for policy development” (p. 253). Public participation objectives include information exchange, education, support building, and representational input (Rowe & Frewer, 2005). Shared characteristics in public engagement processes include multidirectional interactions among the public, experts, and government, which include mutual learning, empowerment, increased awareness, and the importance of considering multiple perspectives (McCallie et al., 2009). These characteristics, as outlined by Rowe and Frewer (2005) and McCallie et al. (2009) are similar to those of SM, suggesting the use of SM may indeed be a means to facilitate public engagement.

Engagement must be accessible to be effective, providing easy entry to information pathways. Therefore, to some extent, the effectiveness of public engagement depends on the choice of engagement mechanism (Rowe & Frewer, 2005). A particular challenge when using SM as an engagement mechanism is determining how the flow of information happens and what level of interactivity is achievable.

One approach is that considered by Rowe and Frewer (2005), who defined three components of public engagement based on the nature and direction of information flow between the source and the public: (a) public communication, (b) public consultation, and (c) public participation. In the schema proposed by Rowe and Frewer, public communication represents a one-way flow of information from an information source to the public, public consultation represents a one-way flow of information from the public to the information source, and public participation represents a multidirectional flow of information between these parties (Rowe & Frewer, 2005). The flow of information can also be defined as giving information, extracting information, and mutual exchanging information, respectively (Newig, Haberl, Pahl-Wostl, & Rothman, 2008). Public engagement ultimately seeks to facilitate a multidirectional flow through participation, although public communication and public consultation still remain components of the engagement process (Rowe & Frewer, 2005). Although this schema is a useful place to begin when characterizing the communication potential and strategies for public engagement, it remains to be seen whether information flow alone is adequate to characterize engagement because no means exist by which to account for action or the intent to take action.

Few studies could be found that link SM and public participation. One study found specifically looked at the role of SM in engagement by examining the relationships among college students' Facebook use, user gratification, and offline political and civic participation.

Park, Kee, and Valenzuela (2009) surveyed college students ($n = 1,715$) and found four primary reasons students participated in Facebook groups: (a) socializing, (b) entertainment, (c) self-status seeking, and (d) information seeking. The study sought to better understand college students' reasons for participating in Facebook groups, the relationship between demographics and Facebook use, and how Facebook group use correlated with their offline political and civic involvement. A correlation between gender and hometown was found between information seeking, and students' year in school correlated with all four factors. Using hierarchical regression analysis, Park et al. (2009) were able to show that the information needs of the Facebook group users were a positive and significant predictor of their civic participation. In other words, Facebook group users who sought information were likely to be actively engaged in civic and political actions in their offline lives. Based on these results, the authors concluded that Facebook might play a significant role in "facilitating youth engagement in civic and political activities" (p. 733).

Social Media in Active Learning Environments

The educational impact attributed to SM ranges considerably. Some educators claim SM have the potential to add functionality, accessibility, and diversity to the classroom (Brown, 2005; Thomas, 2010). In addition, digital networks and existing connectedness are thought to make informal learning pathways possible outside traditional classrooms by connecting informal and virtual spaces (Brown, 2005).

However, these studies focus on theoretical benefits and do not provide empirical evidence. Only one empirical study was found that directly studied the impacts of SM use on student learning. Yu, Tian, Vogel, and Kwok (2010) examined the impacts of online social networking on student learning among university students ($n = 187$). Their study looked at

student cognitive (knowledge, comprehension, and application), affective (attitudes, satisfaction, appreciation of the learning environment), and skill-based outcomes (development of technical skills to solve problems) from a social learning theory perspective. The study focused primarily on social aspects that impact learning rather than cognitive gains, using measures of self-esteem, satisfaction with university life, and student problem-solving as measures of learning outcomes (Yu, Tian, Vogel, & Kwok, 2010). The study found that using Facebook had a substantial impact on participants' development of relationships, integration with peers and gaining of social acceptance, and acculturation to the university. They conclude that removing face-to-face embarrassment allows students to be more comfortable "expressing themselves and interacting with peers and professors" (p. 1500).

Very few studies were found that specifically examined SM use in instructional environments in any capacity. Thus, a broader scope of literature looking at research undertaken that might provide insight into instructional design or potential impacts of SM use in educational settings was undertaken. One such study sought to understand the implementation of multiple Web 2.0 technologies in an active learning environment. Williams and Chinn (2009) studied students' technology literacy resulting from a semester-long project of creating a viral marketing promotion. Students' engagement was assessed qualitatively through observations and student participation in classroom discussions. Students were provided instruction on using Web 2.0 technologies and were encouraged to explore additional tools in their execution of the assignment. Most students were found to already possess the necessary technology skills (albeit at differing levels) to carry out the assigned task before (Williams & Chinn, 2009). Both students and their instructors self-reported increased student engagement. Participatory media were widely used in the activity and during implementation of the campaign; for example, 100% of

students used social networking sites, discussion forums (68%), blogs (15%), YouTube (22%), and e-mail and text messaging (57%). This study demonstrates that students willingly engage in the use of SM in the active learning environment. However, without any baseline information, there was no way to determine whether students' technical literacy or level of engagement were impacted by SM use.

Another such study by Borette and Seltzer (2009) took an organizational analysis approach and studied the effectiveness of Facebook profiles in creating dialog and engagement. They measured the strategies of organizations attempting to create dialogic engagement and their outcomes by conducting a content analysis of Facebook profiles of 50 environmental organizations. The strategies measured included the ease of the interface, the usefulness of information, the number of return visits generated, and content sharing. Outcomes measured included content (user posts, network activity, users' responses to others, and the organization's responses to others) and network connectivity (network extensiveness and network growth). They found a significant relationship existed between return visits and users' responses to others, suggesting users were encouraged by and sought engagement with other site visitors. Retaining visitors depended on network growth and the organization's response to users, suggesting that the responsiveness of an organization or host affected visitor satisfaction. This study provided some insight into effective strategies for creating engagement through SM, albeit not specific to educational environments. Although Borette and Seltzer (2009) demonstrated that organizations must be responsive and users desire a sense of connection to create engagement through SM, they failed to demonstrate how dialog and engagement can be generated or how users perceive the experience, which are essential in active learning environments.

Use of Social Media by Young Adults

Several studies have been conducted that look at how SM is used, how much it is used, and for what purposes. These studies provide insight into student views about SM. For example, Pempek, Yermolayeva, and Calvert (2009) examined college student social networking experiences on Facebook to understand their frequency of use, motivation, and activity patterns. They found that students spent approximately 30 min on Facebook as part of their daily routine. Additionally, they found that students used Facebook to broadcast communications “using a one-to-many style” (p. 227). Student usage patterns were passive, with more time spent observing content rather than generating content. Students mainly interacted with preestablished friends from offline relationships (85%).

In a study by Selwyn (2008), undergraduate students ($n = 1,222$) were surveyed about Internet use, access, and expertise. Students were asked to self-report on their engagement with the Internet for academic information seeking. Selwyn looked at the patterns of use among different groups of students, based on demographics and academic major. Students reported frequent use of online services to access e-mail (80%); for newsgroups, chat rooms, or instant messaging (64%); to visit social networking sites (55%); and for academic purposes (50%). Only 14% of students surveyed had never used social networking sites (Selwyn, 2008). The study found that Internet use for academic purposes was most closely correlated with gender and academic major. Female students (56%) were significantly more likely than male students (42%) to use the Internet when seeking academic information. Students in medicine (59%), social studies (58%), law (53%), and business (52%) reported more academic Internet use than did students in the creative arts (25%), architecture or urban planning (37%), and the humanities (37%; Selwyn, 2008). Natural science majors reported midrange (47%) academic Internet usage.

Selwyn concluded that higher education should focus less on Internet access and the development of skills and more on “understandings of how technology fits into the material students are studying and the nature of learning in general” (p. 20).

Selwyn (2009) researched student education-related use of Facebook through a qualitative text analysis of Facebook wall posts by undergraduate students. The study examined the timing and purpose of Facebook use and the nature of student interactions when using Facebook. The latter were examined with respect to how interactions related to students’ university education in terms of formal education and informal student activity in managing their university studies.

Selwyn (2009) was primarily concerned with how students use Facebook while navigating the university experience. Five main themes were identified: (a) recounting and reflecting on the university experience, (b) exchanging practical information, (c) exchanging academic information, (d) displaying supplications or disengaging and seeking moral support, and (e) banter and humor. The author noted that Facebook was not students’ only mechanism for communication and that concurrent use of Facebook, texting, cell phones, and other social networking sites was common. As such, Facebook was merely part of “larger conversations taking place between students about their university studies” (Selwyn, 2009, p. 170). Facebook was primarily used to maintain strong links in offline relationships (Ellison, Steinfeld, & Lampe, 2007; Selwyn, 2009). Although education and university-related postings constituted the minority of posts, the study demonstrated that Facebook use did not necessarily erode or enhance students’ engagement in their formal studies (Selwyn, 2009).

Perceptions about use of Facebook in the classroom. Conflicting research exists regarding student and faculty *perceptions* of Facebook use in educational settings. Some studies

have shown that students do not change their rating of professors when they become aware of their instructor's presence on Facebook (Hewitt & Forte, 2006). Other studies have demonstrated that students experience higher levels of motivation and affective learning, as well as a more positive classroom climate, when they have access to an instructor's Facebook page (Mazer, Murphy, & Simonds, 2007).

In a study by Hewitt and Forte (2006), university students ($n = 136$) were surveyed about their perceptions of faculty and their encounters with faculty on Facebook. Faculty in this study had established Facebook profile pages. Students were asked about the nature of the interaction with faculty on Facebook and whether they thought faculty should be on Facebook. Two-thirds of the student respondents were comfortable interacting with faculty on Facebook, whereas one-third reported being uncomfortable and cited privacy as an issue of concern.

However, other studies have demonstrated that even though students are more likely than faculty to use Facebook, they are also more open to using Facebook and other SM to support the learning environment (Roblyer, McDaniel, Webb, Herman, & Witty, 2010). In the study by Roblyer et al., faculty ($n = 62$) and students ($n = 120$) were surveyed about Facebook use and their opinions about using Facebook in classroom settings. Students (46.7%) were more likely than faculty (21%) to think using Facebook would be convenient. Faculty (53.2%) was more likely than students (22.5%) to express the opinion that Facebook is for personal social uses and not educational uses (Roblyer et al., 2010). Neither group was overly concerned about privacy. The authors noted a "significant difference between the perceived role of this tool [Facebook] as social, rather than educational" (p. 138).

Madge, Meek, Wellens, and Hooley (2009) surveyed first year undergraduates ($n = 213$) about Facebook use and found that students also viewed SM sites as being primarily for social,

not educational, purposes. However, some students did report using Facebook for informal educational uses, such as connecting with fellow students about assignments (Madge, Meek, Wellens, & Hooley, 2009). Students did not dismiss the idea of using Facebook in a formal educational context, but indicated additional effort would be needed to implement. Indeed, more than half of the students surveyed (53%) suggested ways the social network site could be used as a formal educational tool, such as to create support networks, to post announcements and logistics, and to contact the instructor (Madge et al., 2009).

Issues, Social Implications, and Challenges of Integrating Social Media

Although the primary focus of this study is on the use of SM in the educational context, examining the implications of Internet and SM use from different research perspectives provided additional insight into the challenges and potential benefits of SM use. Research on SM builds on earlier issues attributed to the Internet, which focused on access, involvement (civic and community), and social interaction (Katz & Rice, 2002). Although not specifically focused on SM, DiMaggio, Hargittai, Newman, and Robinson (2001) considered the effects of the Internet and found that rather than being a perfect utopian or dystopian tool, Internet use was more complicated and diverse. According to DiMaggio et al. (2001), five domains of research have persisted in studies on the Internet and SM: (a) inequality, (b) time use and community, (c) political participation, (d) organizational structures, and (e) cultural participation.

Specific issues first considered in the context of the Internet, and later with respect to SM, include access and equity (Jenkins, Clinton, Purushotma, Robinson, & Weigel, 2006; Rainie et al., 2003) and social capital (Adger, 2003; Ellison, Steinfield, & Lampe, 2007). Issues specific to SM use included privacy (Joinson, McKenna, Postmes, & Reips, 2007) and trust (Green, 2007).

Access and the Digital Divide

Access to SM and the digital divide, which is created when access is not available, remain considerations with respect to use of these technologies. The issue has been researched from different perspectives, including demographics (Chen, Boase, & Wellman, 2002; Pfeil, Arjan, & Zaphiris, 2009; Rainie et al., 2003), geography (Chen et al., 2002), access (Rainie et al., 2003), technology and socially derived data (Elwood, 2008), and as a function of online education (Haythornthwaite, 2007a).

However, access and the implications of use have been changing steadily since 2000. The Pew Internet & American Life Project (Pew Research Center, Washington, DC) has tracked Internet and SM use since 1999. Although a digital divide still exists, it is decreasing (Rainie et al., 2003; Zickuhr, 2010). According to Rainie et al. (2003), 95% of young adults (ages 18 to 33) who go online use SM. Since 2006, the Pew Internet & American Life Project data have shown that 79% of all American adults go online (Zickuhr, 2010). Of those who do not go online, 31% are not interested and 12% do not have a computer (Zickuhr, 2010). However, the digital divide continues to be a moving target because Internet and mobile smartphone use increase every day. Social media strategies designed to motivate, activate, and engage will need to include consideration of whether the digital divide is a factor.

Social Capital

Social capital, the way in which people are empowered to act individually and collectively, was an early focus of Internet and SM research (Woolcock & Narayan, 2000). In an early study on the impacts of the Internet on social capital, civic engagement, and the sense of community, Quan-Haase, Wellman, Witte, and Hampton (2002) studied the impact of online involvement in the increase in, decrease in, or supplement to engagement. They found that

Internet use primarily supplemented other forms of involvement and that level of education was the strongest predictor of civic and political participation (Quan-Haase, Wellman, Witte, & Hampton, 2002). In a separate study, DiMaggio et al. (2001) also found that the Internet supported rather than replaced traditional modes of communication. Although these studies were conducted before the development of the current suite of participatory media, they do provide support for increases in social capital, civic engagement, and the sense of community attributable to online activity.

However despite the promise of SM for creating interaction and engagement, access alone to participatory media are unlikely to be enough to ensure engagement (Livingstone et al., 2007). Some degree of social capital may be needed to realize potential between media use and participation (Quan-Haase et al., 2002). One example of SM effects on social capital that looked at undergraduate student use of Facebook and the effect of SM use on building and maintaining social capital was conducted by Ellison et al. (2007) who surveyed college students ($n = 286$) about the benefits of having Facebook friends. This empirical study found a strong association between Facebook use and three types of social capital: (a) bridging, (b) bonding, and (c) maintaining social capital, with the strongest connection being bridging social capital. Social media, they found, were used primarily to maintain offline relationships and maintain social capital through connections. Participants actively used Facebook to keep in touch with old friends and to maintain or intensify relationships that had some component of offline connection. Participation was facilitated through Facebook use because of its ease of use and pathways for participating, and Facebook use lowered barriers to participation “so that students who might otherwise shy away from initiating communication with or responding to others are encouraged to do so through Facebook’s affordances” (Ellison et al., 2007, p. 1162).

Summary

The implications of SM use have been considered from many perspectives. Previous researchers examined different aspects of the Internet and SM to understand the social impacts of using these technologies. Research to date has primarily focused on who is using SM, how people are using SM, what are the social implications of SM use, and how does SM use impact community and civic participation. An early focus of the literature was issues-based with concentration on inequality and access, privacy concerns, and building of social capital. One recent body of literature examined theorized about SM use among the current generation of young adults, digital natives, and made claims suggesting this age group has learning styles and preferences (e.g. connectivity, community learning, and technology use) indicating it would be beneficial to integrate SM into educational settings.

While these early forays into SM research provide information about who, where, why, when, and how much SM is used, very little empirical work has been done connecting SM use with educational objectives (e.g. content knowledge gains, attitude, and civic engagement). Few examples of empirical research were found that furthered the understanding of SM impacts for young adults in learning environments, on the implementation of SM, or on how SM might be used to enhance active learning or learning outcomes to facilitate development of intentional learners. More empirical studies of SM use in active learning environments are needed to determine whether SM can positively impact active learning environments and if so, in what ways, with what types, and with what methods of implementation.

CHAPTER 3

METHODS

This study examined the impact of integrating a social media (SM) component, as a mechanism of engagement, into a community college environmental biology course (the Course). The impact of the intervention was assessed in terms of differential gains in participants' content knowledge, attitudes toward environmental issues with a focus on global climate change, and actions or intentions to act as indicators of public engagement. Additionally, the nature of participants' experience using SM in the Course was examined. The guiding research questions were as follows:

1. What is the impact of an integrated SM component on student content knowledge, attitudes toward global climate change, and indicators of public engagement in an environmental biology course?
2. What is the nature of the student engagement experience when using an integrated SM component in an environmental biology course?

The study used a pretest–posttest, nonrandomized comparison group design. The intervention consisted of the semester-long required use of Facebook integrated into the Course. Facebook had not been used in the Course prior to this intervention. Two Course sections were studied for a full semester (16 weeks). The treatment group received the established Course instruction with the integrated Facebook intervention, whereas the comparison group received only the established Course instruction. The treatment group was selected based on instructor interest in integrating Facebook into the Course. The comparison group instructor used existing course materials, methods, and procedures.

In previous semesters and in the semester with the intervention, Course instruction was delivered through PowerPoint presentations, a computerized course-management system, a course discussion board, laboratory and written assignments, field trips, and in-class discussions. In the established course model, students communicated with the instructor and posted information about the course work and course modules through the college-wide computer-based course-management system, course discussion boards, and classroom discussions. Classroom time was spent discussing assignments, examining case studies related to local and global issues of sustainability, and learning content.

The comparison group was provided access to an optional Facebook component and used the established course instructional methods described above. In addition to these instructional methods, the treatment group used Facebook as a required means of communication, assignment completion, and public engagement throughout the study period.

Participants

Participants were recruited from among community college students enrolled in two intact sections of the Course. Participants registered for sections of the Course and did not represent a random sample, nor were they randomly assigned to the two Course sections. The treatment and comparison groups were determined to be comparable based on demographics, access and ownership of digital devices, and SM use despite non-random assignment. All students enrolled in the two Course sections were invited to participate in the study. Interview participants were recruited separately during the last 2 weeks of the study.

The head of the department offering the Course and the participating instructors for the treatment and comparison sections provided access to the participants. The researcher introduced the participants to the study during the first week of the fall 2011 semester. The participants were

informed that two sections of the Course were being taught using different methods to teach the same material and that inclusion in the treatment or comparison group was determined by course enrollment. Participants provided written consent, and the Course instructors were not privy to the identity of students who consented to participate in the study. Participants' consent allowed access to all students' course grades, survey results, course artifacts, and Facebook posts. Data were provided to the researcher after being coded by a third-party instructor to ensure participant privacy. Participants were notified that the researcher would monitor the Course Facebook pages.

At the beginning of the semester, 33 students agreed to participate in the study, 20 of 25 students (80%) in the treatment section and 13 of 17 students (76%) in the comparison section. Because of attrition, the number of participants who completed the study was the same for the treatment ($n = 13$) and comparison groups ($n = 13$). Background and demographic information was collected from participants through items added to the instrument used to assess participants' attitudes (see the Instruments subsection below). Unless otherwise noted, data reported here are for participants who completed all phases of the study.

The demographic information collected from participants is shown in Table 2. Participants ranged in age from 18 to 29, with the majority being between 18 and 20 years old (77%). The majority of participants (92%) in both sections were attending school full time. Most students had a high school diploma, some college education, or both. At least two-thirds of all students had taken a civics course in either high school or college (77%). No statistically significant differences existed between the two groups prior to the intervention.

Table 2

Participants' Demographic Data

Demographic	Treatment		Comparison		X ²
	<i>n</i>	%	<i>n</i>	%	
Gender					
Female	7	53.8	7	58.3	0.821
Male	6	46.2	5	41.7	0.821
Age group					
18–20	10	76.9	8	66.7	0.568
21–29	3	23.1	4	33.3	0.568
Student status					
Full-time student	12	92.3	10	83.3	-
Part-time student	1	7.7	2	16.7	-
Education level					
High school diploma or less	5	38.5	4	33.3	0.790
Some college	8	61.5	8	66.7	0.790
Civics course	10	76.9	8	66.7	0.568
Race					
Caucasian	10	76.9	8	66.7	0.641
Latina/o	1	7.7	2	16.7	0.641
African-American	0	0.0	1	8.3	0.641
Mixed race	1	7.7	0	0.0	0.641
Asian	1	7.7	1	8.3	0.641

Learning Environment and Intervention Context

Instructional Objectives

The Course was originally proposed and codesigned by one of the study instructors (Course instructor) in conjunction with a team of environmental instructors. Since 2007, the Course has been taught in its current format at a community college in the Midwest for three semesters each year. An online version of the Course is taught in addition to the face-to-face format investigated in this study. Between 150 and 525 students enroll in the Course per year, which fulfills a general life science requirement through classroom, laboratory, and field trip instruction.

The Course was redesigned to be an “interdisciplinary course that brings together numerous natural science disciplines, business, economics, social science, political science, philosophy, and geography” (Course Instructor, 2007, p. 3). The redesigned Course aimed to

[g]o beyond the environmental science content and self-reflection objectives [to] challenge students to become social and environmental entrepreneurs with the scientific, economic, and social skills necessary for risk assessment, environmental decision making, and implementation of sustainable practices in a real-world context. (Course Instructor, 2007, p. 2)

The Course emphasized the individual development of “entrepreneurial skills such as participation (both in and out of the classroom), scientific evaluation, recognizing and utilizing opportunity and the marketing of ideas” (Course Instructor, 2007, p. 10). Instructors provided opportunities for students to make connections among scientific content, social values, and public engagement.

As shown in Table 3, Course educational objectives fell mainly into three categories: (a) content knowledge, (b) environmental values and attitudes, and (c) action.

Table 3

Course Educational Objectives by Category (Partial List)

Category	Educational objective
Content knowledge	Demonstrate understanding of basic environmental science principles and increase scientific literacy regarding environmental science
	Gain awareness of global, national, and local environmental problems
Attitude	Demonstrate the necessity of core values in helping students make ethical, personal, social, and professional environmental decisions
	Change personal attitudes and behaviors toward more environmentally sound beliefs (sustainability) and practices
Action	Generate a more informed voting citizen in matters of environmental concern
	Demonstrate the ability to use technology to assess, retrieve, process, and communicate information

Course Design

The Course content is presented in nine modules that build an integrated understanding of environmental issues related to (a) ecology, (b) energy, (c) demography, (d) stuff (i.e., consumption and waste), (e) making choices, (f) toxins, (g) air quality, (h) water quality, and (i) food security (See Appendix A for Course Syllabus). The *making choices* module is designed to facilitate an understanding of the student’s individual environmental choice-making process. This module integrates concepts from environmental values, law, risk assessment, information source validation, ethics, and environmental justice concerns.

Demography is a 1-week module composed of two 50-min classroom periods and one 2-hr laboratory session. Each of the remaining eight modules spanned 2 weeks and consisted of four 50-min classroom periods and two 2-hr laboratory sessions, which often included field trips. Additionally, global climate change was selected as a central theme for the fall 2011 classroom

sections. Throughout the semester, the nine course modules were taught and discussed in relation to issues of global climate change.

Each module consisted of approximately 5 to 10 pages of workbook readings, a preinstructional probing exercise referred to as the Preflight Quiz, classroom discussion, and an end-of-module online quiz. Seven “footprint” assignments, designed to help students understand personal environmental impacts, were conducted throughout the Course in the modules on ecology, energy, demography, waste, toxins, carbon, and water (See Appendix B for Example Footprint Assignment). Additional details about footprint assignments and their use in the intervention are provided in the next section. The final examination was conducted orally. Students were given a handout with five final examination questions early in the semester, for which they were expected to prepare answers (See Appendix C for Final Examination). Final examination preparatory artifacts and notes were collected from students.

Intervention

The intervention was designed in collaboration with the treatment group instructor. To ensure fidelity of the treatment intervention, weekly instructor meetings were held to discuss Course logistics and topics to be covered the next week so that all instructors were providing the same level of instruction. Additionally, the treatment group instructor and researcher met weekly to discuss the intervention. Because of the potential for emergent uses of Facebook and diffusion of treatment, the researcher conducted 25 classroom observations, distributed among the treatment and comparison sections. The treatment group instructor used the course-management system to record assignments and Facebook use after each class period. Additionally, the treatment and comparison group instructors completed an SM feedback form after each class, on which the instructors made note of SM questions, Facebook activity, and instructional concerns,

if any arose in the classroom sessions. The SM instructor form was accessed and submitted to the researcher via SurveyMonkey after each class period (See Appendix D for Social Media Feedback Form).

The original intention was to use both Facebook and Twitter as SM tools in the intervention. Facebook was chosen as the preferred SM platform because of its ubiquitous use, accessibility, minimal learning curve, and group page option (Facebook, 2011; Roblyer et al., 2010). Twitter was also chosen because of its ubiquitous use and apparent ease of implementation. However, after using both Facebook and Twitter in Weeks 1 to 5, it was determined that only one form of SM should be used. This decision was made to simplify the demands on student time, to simplify the difficulty in tracking usage, and in response to negative student feedback regarding Twitter use.

Treatment group instruction included the integrated Facebook assignments and activities using Facebook throughout the 16-week fall 2011 semester. Members of the comparison group had an optional Facebook page, but they were not required to use it for Course assignments. Instructors of the treatment and comparison groups posted information (primarily in the form of interesting course-related articles, YouTube videos, and Course logistics) on the Course Facebook pages. Separate Facebook group pages were established for each of the two Course sections to help address potential for diffusion of the treatment. Students were provided with an instruction sheet explaining how to sign up for the course Facebook page (see Appendix E for SM Classroom Instructions). Fifteen minutes during the first week of the Course was devoted to in-class training on the use of Facebook, and additional student questions were answered in class or online as they emerged. Students were provided extra assistance and training as needed.

As shown in Table 4, assignments requiring Facebook use for the treatment group was balanced with similar assignments for the comparison group not requiring the use of Facebook. The number of assignments was equal for both groups. Facebook assignments were similar to existing course assignments, and participants' time on task was closely monitored in both groups. Class discussions, current event updates, and communication in the comparison group continued to take place through existing electronic mechanisms, the computerized course-management system, in-class discussions, and paper-and-pencil exercises. The footprint assignments were conducted as in-class assignments in the comparison group.

Table 4

Summary of Time Spent on Class Assignments

Week	Module	SM treatment group	Comparison group
1	1 (Ecology)	Ecological Footprint FB (30 min)	Ecological Footprint (30 min)
		Intro to SM (15 min)	Intro to SM (15 min)
2	1 (Ecology)	Attitude Survey (link on FB; 30 min)	Attitude Survey (link on FB; 30 min)
3	2 (Energy)		
4	2 (Energy)	Home Energy Audit (1 hr)	Home Energy Audit traditional (1 hr)
		Posted article on FB class discussion (10 min)	Posted article on FB (10 min)
5	3 (Demography)	Demography—Posted population movie watched in class (45 min)	In-class discussion on demography (45 min)
		Tweeted energy reduction actions and posted global energy use media on FB (15 min)	Energy reduction action discussion (15 min)
6	4 (Stuff)	FB site critique (10 min)	Site critique class discussion (10 min)
		Assigned Stuff Footprint (10 min)	Assigned Stuff Footprint (10 min)

(table continues)

Table 4 (continued)

Week	Module	SM treatment group	Comparison group
7	4 (Stuff)	Stuff Footprint traditional (1 hr)	Stuff Footprint traditional (1 hr) (combined desire, stuff, and waste)
		Assigned FB post on local recycling obstacles (post plus 2 comments; due 10 Oct; 10 min)	Assigned environmental issue group presentation (10 min)
8	5 (Making Choices)	FB Six Americas Survey (30 min)	Six Americas Survey (30 min)
		Public engagement (3 hr)	Public engagement (3 hr)
		Posted obstacles to local recycling on FB, posted two comments (15 min)	Bring in article about local recycling (15 min)
9	5 (Making Choices)	FB environmental issue critique (30 min)	In-class discussion: Making choices (30 min)
		FB post on dengue fever case study combined in-class and FB post (20 min)	
10	6 (Air)		Environmental solutions group discussions (20 min)
11	6 (Air)	Carbon Footprint (1 hr)	Carbon Footprint (1 hr)
		FB post media on global air quality; post two comments (15 min)	In-class discussion on air quality (15 min)
12	7 (Water)	FB post on how climate change is affecting our place in the world (20 min)	In-class discussion on global climate change (20 min)

(table continues)

Table 4 (continued)

Week	Module	SM treatment group	Comparison group
13	7 (Water)	Water Footprint class activity (1 hr)	Water Footprint (1 hr)
		FB post on global water issue (5 min)	Bring in article about water issue (5 min)
14	8 (Food)	FB post on one sustainable food, one nonsustainable food, and why (5 min)	In-class discussion (5 min/person)
15	8 (Food)	Food miles activity (20 min)	Food transportation audit (30 min)
		FB Hungry Planet; compare weekly food purchases (10 min)	
		FB post on answer to lab question	

Note. FB = Facebook; SM = social media.

Intervention for Treatment Group

The intervention consisted of required Facebook use for the completion of 11 assignments as seen in Figure 1. Further Facebook integration included directing students to post articles with required comments or posts, communicating spontaneously with students on current environmental events, and using Facebook in class to voice opinions and search for information related to the class discussion. The final examination included two opportunities for students to express their intent to act or summarize their actual engagement actions (Appendix C).

Although Facebook was also used for Course logistics, the intervention was focused on the value-added nature of Facebook to (a) provide real-time student-to-student and student-to-instructor interaction, (b) expand class discussion beyond the physical space of the classroom, (c) provide a venue for students to contribute content and ideas to the Course, and (d) incorporate Facebook as an engagement tool beyond its usual function as a social tool. Throughout the semester, emergent uses of Facebook were observed and noted by the researcher. These included Facebook posts between the instructor and participants, such as, environmental holidays, updates on current environmental issues, interactions with an external expert, continuation of classroom discussions and questions, and course logistics. Additional emergent uses occurred during researcher-attended class sessions where the instructor was observed to use Facebook in classroom discussions using a computer and projection system to display the Facebook page in-class, making students aware of relevant content, such as Facebook posts, article links, and Internet videos. Facebook posts were discussed frequently in class discussions, and participants were encouraged to post information in real time in class on questions that arose during class.

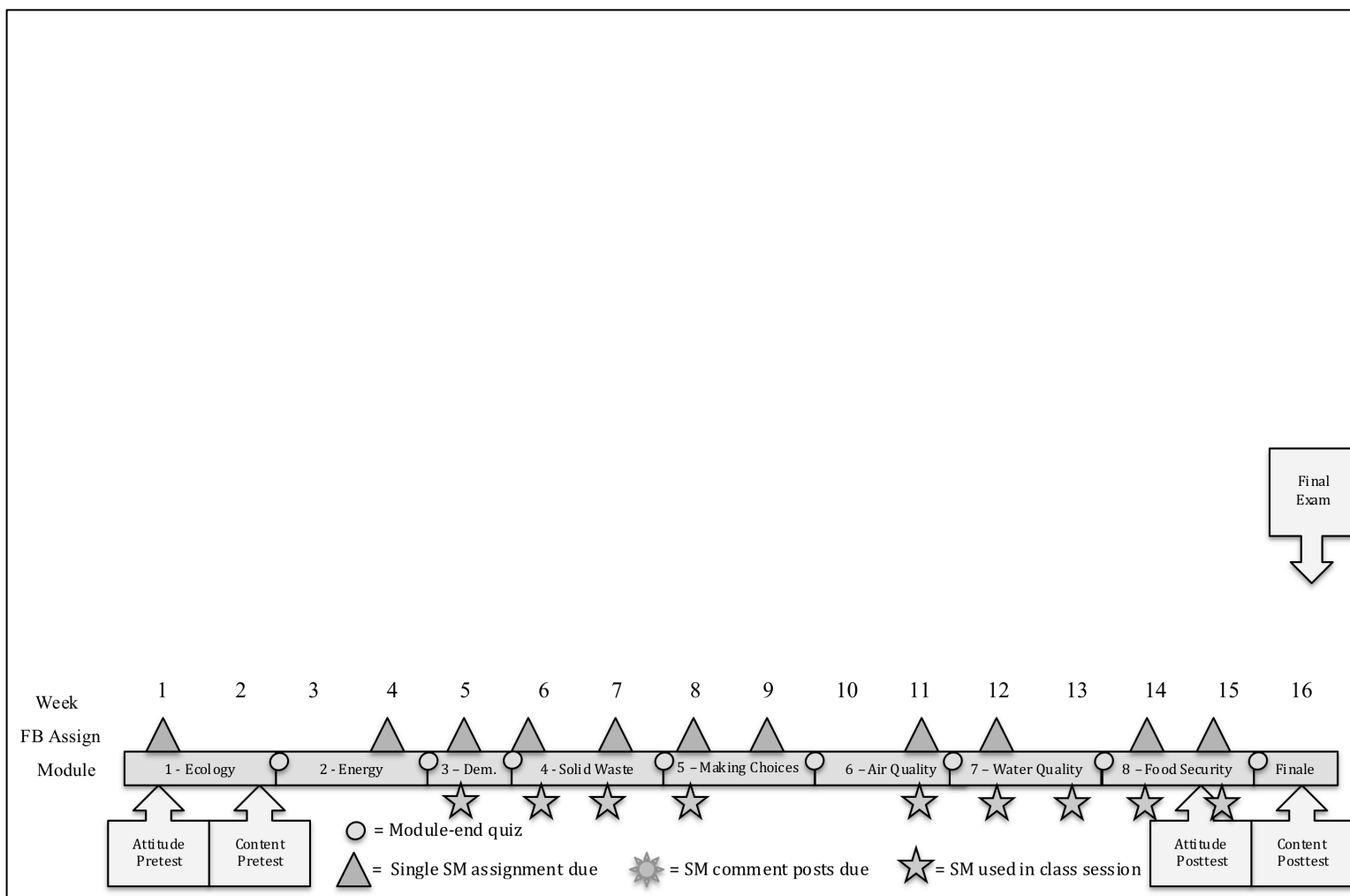


Figure 1. Intervention map for the treatment and comparison groups during the Course. The social media (SM) assignments shown are for the treatment group. The comparison group had similar assignments that did not require SM. FB = Facebook; Dem. = Demography.

Footprint Assignments

The Course included footprint assignments in the ecology, waste, air quality, and water modules to examine individual impacts in these areas. *Footprint* is defined for the purpose of the assignments as “the impact one’s lifestyle has on the natural capital of the earth, which is calculated by recording everything one purchases, uses, and throws away” (Appendix B). An introduction to online computer-based footprint calculators was provided for the treatment and control groups. In the energy module, students were required to keep a log of all their energy use for a week and any measures used to reduce the amount of energy used. Participants in the treatment group used Facebook to complete the footprint assignment as part of the intervention during Weeks 3 and 4. The Facebook-integrated footprint assignment required that posts be made on Facebook. Participants’ posts were also discussed in class.

Instruments

The impact of the integrated Facebook component on participants’ differential gains was measured in three areas, as shown in Table 5: (a) content knowledge, (b) attitudes toward global climate change, and (c) public engagement actions or intentions to act. Social media use was measured using Facebook statistics and posts. Participant demographics and access to SM and digital devices were measured through the attitude survey. Content knowledge gains are defined as those measured by the instruments used, which include a course content knowledge test and self-report questions on module-end quizzes. Attitude was measured by a global climate change attitudes survey and by self-reported engagement action questions on the module-end quizzes. Indicators of public engagement were measured by Facebook posts, questions from the global climate change attitudes survey, self-reported engagement action questions on the module-end

Table 5

Summary of Research Questions and Instruments Used to Collect Data

Research questions	Group	Surveys	Interview	Review posts	Self-report items	Final examination documents
What is the effect of an integrated social media component on students' content knowledge (awareness), attitudes toward public engagement, and indicators of public engagement in an environmental biology course?						
a. Content knowledge	Treatment	Pre/post			X	
	Comparison	Pre/post			X	
b. Attitudes toward public engagement	Treatment	Pre/post	X		X	
	Comparison	Pre/post	X		X	
c. Indicators of public engagement	Treatment			X	X	X
	Comparison			X	X	X
What is the nature of students' engagement experience when using an integrated social media component in an environmental biology course?	Treatment		X	X	X	
	Comparison		X	X	X	

sustainability diagrams, final examination notes, and preparation materials generated during the study. The nature of students' experience with the integrated Facebook component was examined through interviews, Facebook posts, and self-report items.

Facebook Use

In order to determine if differences existed between the treatment and comparison group SM use at the start of the study, participants were surveyed about the frequency with which they used six types of electronic communication and SM: (a) e-mail, (b) text messaging, (c) social network sites, (d) blogging, (e) Twitter, and (f) YouTube. (See Appendix F for Climate Attitude Survey, Question 39).

In addition, descriptive metrics provided weekly by Facebook to page administrators (instructors and researcher) were used to further characterize Facebook use among participants in both groups. Facebook weekly summary statistics provided by Facebook and actual Facebook posts recorded and observed were used to assess: (a) the extent to which treatment and comparison group participants used Facebook and to compare their use, (b) examine the interactivity of posts, and (c) understand the nature of participants' engagement.

Weekly Facebook Page Insights and summary statistics were examined for numbers of total *likes*, total *reach*, and number of posts (Facebook, 2011). *Total likes* were defined as the "number of unique people who like your Page" (Facebook, 2011, p. 4). *Total reach* was defined as "the number of unique people who have seen any content associated with your Page in the last seven days" (Facebook, 2011, p. 4).

To further understand the distribution of the Facebook provided statistics, the frequency, type, and interactivity of Facebook posts were tracked weekly for treatment and comparison group participants and instructors (Table 6). Tracking was conducted by examining the Facebook

Table 6

Facebook Posts Tracked Weekly (by Type)

Instructor	Participant
Likes	Likes
Content	Content with comment
Assignment	Content without comment
Comment	Assignment
Class logistics	Question
Other (i.e., expert q & a)	Comment on instructor post
	Comment on student post
	Other

page and recording numbers and types of Facebook posts. Post types were defined based on commonly observed activities on the Facebook page throughout the semester.

An example of the types of post interactions examined for directionality of the interaction and themes related to the nature of the students' experience with Facebook in the context of the Course is shown in Figure 2.

Ownership and Access to Electronic Devices

Participants were surveyed at the start of the study about their ownership of and access to electronic devices and SM to determine if differences existed which might impact study results, (Appendix F, Question 49). Participants were asked to report on if they owned, borrowed, or had access to computers, smartphones, tablets, and other electronic devices.

Student 1 <http://www.youtube.com/watch?v=yy08iYpyhH0>



Nika Water "The Water Crisis"
www.youtube.com

Nika Water presents the "Water Crisis". This video represents the current problem facing millions of people around the world who suffer from lack of clean wa...

Like - Comment - Share - 20 November at 23:00 -

Student 1 This video explains that the population boom a major shortage in clean water and poverty are the ones that suffer.
20 November at 23:01 - Like

Student 1 s an organization that is working on to bring clean water to third world countries.
20 November at 23:02 - Like

Student 2 Interesting that we have never heard of that water company since they are really trying to help other countries get water.
20 November at 23:32 - Like

Student 3 This is probably a reason why people in third world countries usually have more children. The life expectancy is so low that they know many of their offspring will not survive past adolescence. And they need children to support them by fetching water for example. That water will shorten their lives so there must be enough children left behind to repopulate the area.
21 November at 00:34 - Like

Instructor Think back to the module on demography, too... the reasons are many. 3rd world is usually poorer, no access to or \$ for birth control, no knowledge of options, low life expectancy, need for children to farm and work.....
Thursday at 00:33 - Like

Write a comment...

Figure 2. Screen capture of a Facebook “conversation” and an instructional moment.

Content Knowledge Test

Content knowledge was measured using a pretest–posttest Course content knowledge test administered to students in all sections (See Appendix G for the Content Knowledge Test). The Course content knowledge test was 38-items and had two parts: (a) the existing 30-item course content knowledge component (used in all previous semesters), and (b) an 8-item set of

questions specific to the global climate change theme for the semester. The content knowledge instrument was administered during Week 1 (pretest) and Week 16 (posttest) of the Course.

Face validity and content validity for the 30-item content knowledge test were established through a process that began with a 75-item examination written by a veteran faculty member. In the 2007–2008 school year, a team of 12 faculty members teaching or associated with the teaching of environmental biology reviewed the 75-item examination and removed questions that were unclear or that did not reflect updated course content. These faculty members also modified some questions and added several others to reflect updated course content. The final survey instrument had 30 questions. A group of six students reviewed the 30 items and provided feedback to help clarify the items. Since the 2008–2009 school year, between 75 and 175 students per semester and all new teaching staff ($n = 6$) have taken the test, with consistent and reliable results.

The Course instructor selected eight additional questions specifically related to the semester global climate change theme, an area not extensively covered on the original 30-item instrument (Appendix G, Questions 31 to 38). The additional eight items were selected from an instrument on American global climate change knowledge (Leiserowitz, Smith, & Marlon, 2010). Criteria for selection were: (a) alignment with Course content, (b) instructional goals, and (c) expected student knowledge gain. These items were adapted from a larger 55-item questionnaire used to measure knowledge of climate change and misconceptions among the American adult population (the Climate Knowledge Instrument by Leiserowitz, Smith, et al., 2010). This Climate Knowledge Instrument was developed using a nationally representative sample of American adults, aged 18 and older, weighted to correspond with US Census Bureau demographic and Gallup political party identification parameters for the United States. The

initial 55-item survey was administered between June 24, 2010, and July 22, 2010, to 2,030 American adults. Face validity and content validity were established through citations to published literature (detailed in an appendix to the original instrument report) for each question (Leiserowitz, Smith, et al., 2010). The content validity of each question was established through the literature. The lead author granted permission to use this instrument in the present study.

Final Examination

The final examination was a five-question oral exam (Appendix C). The open-ended essay questions were provided to the students early in the semester, and they were encouraged to prepare their answers throughout the semester. The instructions for the final examination were reviewed in class in Weeks 13, 14, and 15. Examinations were administered orally. Students chose three of the five questions to answer at random upon arrival at the examination site (by drawing pieces of paper from a hat). Students were expected to prepare answers to all five questions and were required to submit preparation notes and materials for each question at the time of the examination. Examination preparation materials were collected by the instructors upon completion of the exam and were included as a data source in the study as part of the aforementioned Course artifacts. Questions 4 and 5 were deemed relevant for the present study because they focused on the development of a personal action plan and the creation of a public engagement plan for a local environmental issue.

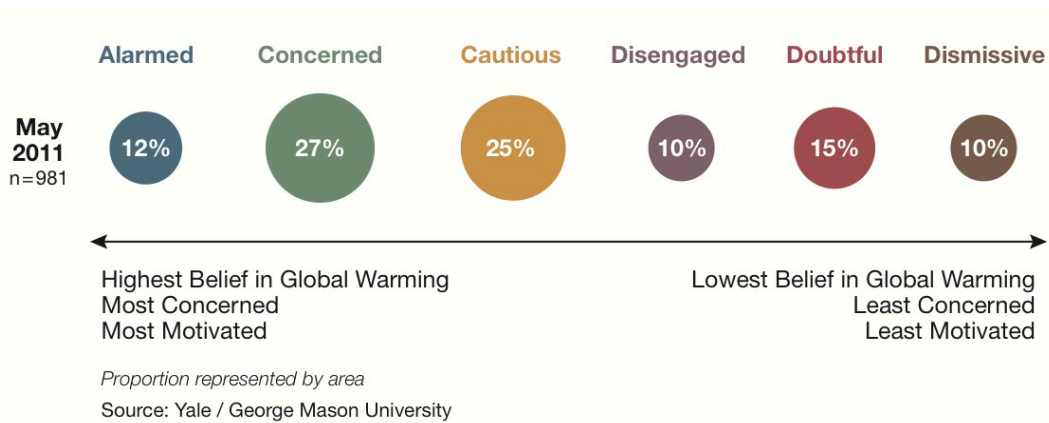
Attitude Instrument

A survey instrument was used to examine participants' attitudes, beliefs, and motivations about global climate change and engagement activities. The Global Warming's Six Americas screening tool, a 36-item survey developed by Leiserowitz, Maibach, et al. (2010), was administered to treatment and comparison group participants near the outset (Week 2) and at the

conclusion (Week 14) of the study (Appendix F). The instrument was administered through SurveyMonkey via a website, e-mail, and Facebook. The instrument was completed as an in-class exercise for students in both the treatment and comparison groups.

Maibach, Leiserowitz, Roser-Renouf, Mertz, and Akerlof (2011a) developed the Six Americas screening tool, a discriminant analysis instrument, to assess participants' attitudes and level of engagement related to global climate change (attitude survey). The attitude survey is based on audience segmentation research, which takes into account the actions, reasons, and policy preferences of independent populations. As can be seen in Figure 3, once analyzed, the attitude survey characterizes respondents along a 6-point continuum of global climate change attitudes, from Alarmed (very concerned about climate change) to Dismissive (does not believe in climate change). The segmentation is based on four major categories: (a) beliefs about global warming, (b) level of involvement with the issue, (c) actions, and (d) policy preferences.

Maibach et al. (2011a) developed the instrument through a survey conducted with a nationally representative sample of American adults ($n = 2,164$). Six distinct attitude classifications were identified based on individuals' beliefs about global warming, level of engagement, level of action, and expectations for action by the government, businesses, and citizens (Leiserowitz, Maibach, & Roser-Renouf, 2008). Validity was established by linear regression using demographics (age, gender, income, education, marital and work status, and race), political ideology, and segment membership as predictors of an index of support for nine federal greenhouse gas-reduction policies. Political ideology ($p < .001$) and audience segment ($p < .001$) were determined to be significant predictors of policy support (Maibach, Leiserowitz, Roser-Renouf, Mertz, & Akerlof, 2011b).



Attitude category	Description
Alarmed	Respondents are convinced global warming is happening, is the result of human activities, and is a serious and urgent threat. They are actively involved in the issue already by taking action and making changes in their personal lives. They support aggressive policy actions.
Concerned	Respondents are convinced global warming is happening and a serious problem. They do support vigorous national policy actions but are less involved in the issue. Group less likely than Alarmed group to take personal actions.
Cautious	Respondents believe global warming is happening and is a problem, but are less convinced than the Alarmed or Concerned groups about causes. Do not view global warming as personal threat. Do not feel sense of urgency to address the issue on the personal or policy level.
Disengaged	Respondents have not thought much about the issue of global warming and most are likely to say they could easily change their minds about global warming.
Doubtful	Respondents are split evenly between thinking global warming is happening and not knowing if it is happening. Many believe global climate change is caused by natural environmental changes and humans will not be harmed in the near future, if at all. They believe America is already doing enough to address the issue.
Dismissive	Respondents do not believe in global warming and do not think global warming is a threat to people or nature. It is not an issue requiring personal or policy initiatives. They are actively engaged in opposition to the issue.

Figure 3. Global Warming’s Six Americas distribution as of 2011 and a description of each category. Figure reprinted with permission from author.

Self-Report Items

Indicators of public engagement were measured through four self-report questions added to the end of each module-end quiz (See Appendix H for the Self-Report Questions). The self-report questions were the same for each module. The first question asked participants to self-report on previous knowledge about the current module subject using a Likert scale of 1 to 5 (1 = nothing to 5 = a lot and could explain to others). The second and third questions asked participants to answer the questions, “Did the module impact or change your thinking about the subject and in what way?” The fourth question provided a list of 10 engagement actions or intentions to act. Participants were asked to check whether they had undertaken any of the listed actions. Actions were defined as: (a) writing a letter to an editor, (b) writing to your Congressperson, (c) signing a petition, (d) making different shopping choices, (e) discussing with friends and family, (f) volunteering with an organization or for an event, (g) seeking additional information about a topic (from experts or media sources), (h) sharing information with one’s social network using Facebook, (i) sharing information with one’s social network using traditional media, and (j) reducing one’s individual impact (e.g., reporting on recycling, shortening one’s shower, using public transportation, reducing waste).

Artifacts. Participants’ Course artifacts, including open-ended responses on module-end quizzes, attitude survey responses, sustainability diagrams, final examination preparation materials, and interview responses, were examined for indications of SM use and engagement.

Interviews

The nature of the participants’ Facebook engagement experience was examined through open-ended interviews conducted at the end of the semester. The interviews were used to gain a richer sense of the intervention from the participant and instructor perspective, specifically in the

areas of Facebook use and the public engagement aspects of the Course. Additionally, interviews were used to determine if diffusion of treatment occurred between the treatment and comparison groups. Major themes explored included SM issues (social capital, privacy), Facebook use (logistics, convenience), posting characteristics, learning environment observations (community, support, instruction), and public engagement (actions, intentions to act, sharing information).

Participants in the treatment group were asked about background information and to describe their SM use before the intervention commenced (See Appendix I for the Interview Protocol). Participants were also questioned about how they experienced components of the intervention, such as the use of Facebook in the class, their understanding and sense of public engagement, their perceptions of environmental issues, their engagement in the learning environment, and their use of Facebook inside and outside the Course. Additionally, participants were asked to comment on what about Facebook use in the Course they enjoyed or disliked, and what they would recommend for Facebook use in future courses.

To determine if diffusion of treatment had occurred, students from the comparison group were also interviewed and asked to reflect on their engagement as a result of the Course without the Facebook intervention component. Because the comparison group was not required to use Facebook, the interview questions focused on background information, their experiences in the Course, their environmental stance, their SM use before and during the intervention, and their impressions about using SM in educational settings.

Classroom Observations

The researcher conducted classroom observations throughout the intervention, making note of students' participation in class discussion, their attitudes and indicators of public engagement, their Facebook experiences, and their exploration of content through Facebook. For

each class period observed, field notes were collected on participants' discussions of content, participants' mention of SM use and engagement actions taken outside class, the questions asked by the instructor and participants that were specific to Facebook assignments or use, the directionality of discussions (denoted through arrows and the frequency of comments), computer and electronic device use of Facebook while instruction was taking place, continuations of discussion from the classroom to Facebook and from assignments into the classroom, in-class use of Facebook by the instructor, and questions and content requests that were fulfilled by using Facebook.

Classroom observations were conducted in both the treatment and comparison group course sections during the two weekly lecture class sessions. One additional class session was reserved for laboratory exercises or field trips. At the recommendation of the instructor, the laboratory or field trip sessions were not observed because little to no discussion of classroom activities, lectures, or assignments took place during this time. Instruction was accompanied by specific laboratory exercises conducted in class, which did not relate to potential Facebook assignments.

However, instructors were queried to determine whether participants discussed any content or activity in the laboratory that was related to class discussions. Of the 30 class lecture sessions possible for the semester, observations were conducted in 53% of the treatment group class sessions ($n = 16$) and 30% of the comparison group class sessions ($n = 9$). Field observations were recorded in a field notebook and included the content and scope of Course discussions during class sessions for each section.

Data Analysis

Participants, Participant Devices, and Social Media Use

Participant demographics. Chi-square analysis of the demographic variables for the treatment and comparison groups was conducted to determine if any statistically significant differences were present between the two groups in gender, age, educational level, civics education, or race prior to the interventions.

Digital device ownership and access. Chi-squared analysis was conducted on participant self-reported data about digital device ownership and access to determine if there were statistically significant differences between the treatment and comparison groups.

Social media use and Facebook statistics. Descriptive data was used to understand prior SM use and Facebook use during the intervention.

Prior social media use. Chi-squared analysis was conducted on participant self-reported data about SM use prior to the intervention to determine if there were statistically significant differences between the treatment and comparison groups. Responses were collected on a Likert scale with five points (never = 0, hardly ever = 1, sometimes = 2, often = 3, and very often = 4). Responses were combined to form two groups, infrequent (never to sometimes) and frequent (often to very often), to increase the potential sensitivity of the Chi-squared analysis.

Posts. The data on posts, as reported by Facebook, were found to be difficult to attribute to specific users. These data also did not accurately reflect the posting activity of either the treatment group or comparison group as observed by the researcher. To gain a more thorough understanding of participants' Facebook activity and usage patterns, the researcher monitored data from the Facebook pages for the treatment and comparison group courses weekly for the frequency, type, and directionality of posting by the researcher. Categories monitored for

include: (a) comments, (b) articles, (c) links, (d) videos, (e) maps, (f) surveys, (g) other, and (h) games.

An independent samples *t*-test was conducted to determine whether statistically significant differences in the number of posts were present between the treatment and comparison groups.

Likes. The data were found to have an anomalously high number of *likes* and activity early in the semester, which was not reflected in observations. Upon further examination of the data and discussion with the comparison group instructor, the unusually high number of *likes* was found to be the result of personal instructor contacts using the Facebook page to communicate in a noninstructional context. To account for a potential effect, the data were corrected to remove the potential effect of personal activity of the comparison instructor. The data were corrected by calculating the mean for both groups ($M = 49$). The calculated mean was then substituted for the inflated data points, and the mean number of site *likes* was recalculated.

An independent samples *t*-test was then conducted to determine whether statistically significant differences between the number of *likes* for the treatment and comparison groups.

Site visits. An anomalously high site visit count for the comparison group was found in Week 4 ($n = 239$), which was found to result from substantial activity by personal contacts of the comparison group instructor. The data were corrected by calculating the mean for both groups ($M = 49$). The calculated mean was then substituted for the inflated data points, and the mean number of site visits was recalculated.

An independent samples *t*-test was then conducted to determine whether a statistically significant difference number of visits existed between the treatment and comparison groups.

Social Media Use Index

An index of SM use was calculated for each participant in the treatment and comparison group as a measure of individual participants' engagement with Facebook in the study. To create the SM Use Index, Facebook posts were analyzed for frequency and interactivity. Frequency was determined by counting individual posts per participant throughout the semester. Based on the public engagement typology proposed by Rowe and Frewer (2005) and on the Rafaeli and Ariel (2007) interactivity model for assessing computer-mediated communication, *interactivity* was defined as a process-related variable representing the degree to which participants Facebook post conversations represented simple to complex interaction. Posting interactivity was used as a proxy for engagement, which was measured by tracking the directionality of Facebook interactions or conversations through posts for the semester. Directional communications were assigned to the original participant. Each Facebook interaction (collection of posts) was given a numerical score based on the number of posts generated between a participant and the instructor, or between participants.

As shown in Table 7, the interactivity value was based on the directionality of the posting interaction, with a single post having the lowest value and higher values indicating more posting interaction was generated. The lowest level of interactivity or directionality, a single post, was given a score of 1. If a post received a response, meaning two participants or the participant and instructor exchanged posts, a score of 3 was given, to indicate a greater degree of interaction. Finally, if a post resulted in multiple interactions between participants or between participants and the instructor, a score of 5 was given, to indicate the highest degree of interactivity.

Table 7

Classification Scheme for Social Media Interactivity

Interactivity	Definition	Value
Uni-directional	Single post	1
Bi-directional	Exchange of information through student-to-instructor or student-to-student interaction	3
Multi-directional	Exchange of information through student-to-instructor-to-student, student-to-student-to-student, and other variations thereof	5

The SM Use Index score was calculated for each participant by tallying the number of posts, multiplying each post by a corresponding quality score (i.e., 1, 3, or 5), and finally summing the individual scores. The higher the SM Use Index, the greater was the participant’s level of involvement in the learning environment through Facebook. The SM Use Index scores were calculated only for participants who completed the study. However, if a participant who did not complete the study participated in an exchange posted by a participant who completed the study, the interaction was counted toward the interactivity. The SM Use Index calculated for the comparison group participants yielded all indices equal to zero because no posts were made by this group.

Content Knowledge Data Analysis

Content knowledge test. The content knowledge pretests and posttests were scored using the Course computer-management system, which provided a report on the raw score per student. The 38-item Course content test was divided into two parts for analysis: (a) the Course original 30-item pretest–posttest (raw score of 30) given in previous semesters, and (b) the global climate change specific 8-item questions (raw score of 8) added for the intervention. The two sets of items were analyzed separately by the researcher so that the 30-item content knowledge

instrument could be compared with previous semesters of the course as needed. The eight climate change specific items were only used during the Course during the intervention period and related specifically to the global climate change theme.

Analyzing pretest for initial group differences. An independent samples *t*-test was used to compare treatment and comparison group pretest scores on both the 30-item and the 8-item instruments. This procedure allowed any initial differences in content knowledge between the intervention and comparison groups to be measured.

Analyzing pretest–posttest for knowledge gains. The treatment group pretest and posttest raw scores on the 30-item and 8-item tests were compared using a repeated measures *t*-test, or dependent *t*-test, to assess content knowledge gains. However, because of the limited amount of comparison group posttest data collected ($n = 2$), content knowledge gains from the pretest and posttest scores were not calculated for this group.

Analyzing pretest–posttest for intervention impacts across semesters. Because comparison group posttest data were inadequate for analysis, it was necessary to analyze for potential differences in knowledge gains resulting from the intervention using a different method. Therefore, pretest and posttest scores on the 30-item content knowledge instrument for the treatment group were compared with a matched sample from a previous semester taught by the same treatment instructor.

The treatment group instructor selected the matched sample to serve as a proxy comparison group. The criteria for matching were based on the semester (fall) and time of day (10:00 am), which were the same for both groups. Analyzing the treatment group using Facebook and a second section without the Facebook intervention taught by the same instructor allowed the researcher to control for a potential instructor effect.

An ANOVA was used to compare treatment and matched comparison group pretest and posttest scores on the 30-item content knowledge test.

Attitude Survey Analysis

The 36-item instrument was analyzed using discriminant function scripts for SPSS (IBM Corporation, Armonk, New York) as detailed in the instrument screener's manual (Maibach et al., 2011b). A data set was created, and items were coded in accordance with the scripts detailed in the manual. Means were calculated and assessed for nonmissing values. Only cases with 80% or more nonmissing values were used. Substitutions for missing values were made if needed because some variables were dummy coded for the discriminant analysis (Maibach et al., 2011b). Participants' attitudes were then characterized along the aforementioned 6-point continuum.

A one-tailed Wilcoxon signed-rank test was used to further analyze for statistically significant differences between the treatment and comparison groups in participants' attitudes about climate change. The Wilcoxon signed-rank test is a nonparametric test of statistical significance used with two samples with repeated measures, such as the attitude pretest and posttest in this study (Vogt, 2005; Corder & Foreman, 2009).

The Wilcoxon signed-rank test was conducted using the attitude pretest compared to the posttest results such that the sign would serve as an indicator of the direction of shift in attitude during the intervention. Thus, for the purposes of this study, a *negative shift* was defined as moving from a higher rank to a lower rank, indicating increased concern in global climate change. A *positive shift* was defined as moving from a lower rank to a higher rank, indicating decreased concern in global climate change.

Data Analysis for Actions and Intention to Act

Self-reported module-end quiz items. Self-reported items on the unit-end quizzes were analyzed for frequency of the ten listed actions over the course of the study (Appendix H). Frequency was defined as the number of actions or intentions to act reported. For each student, the total number of actions or intentions to act was tallied and reported as a score, with 1 point per action. Ten actions per module were possible, for a total raw score of 0 to 80. Self-reported items were collected weekly, representing a detailed semester-long accounting of actions taken.

Attitude survey actions and intentions to act. Two questions specific to engagement with respect to global climate change were added to the attitude survey to determine the frequencies of three actions (volunteering, posting comments, writing letters) taken in the previous 12 months and the frequencies of intentions to act on the same three actions in the coming 12 months (Appendix F, Questions 37 and 38). End-of-semester attitude scores were used as a proxy for past actions and future intent. Frequency of actions was scored on a collapsed Likert scale as follows: *never* = 0, *some actions (n = 1 to 3) or intentions to act (n = 1 to 3)* = 1, and *many actions or intentions to act (n ≥ 4)* = 2. A total range of points from 0 to 12 was possible for all six actions and intentions to act.

Final examination Questions 4 and 5. As discussed above, students chose at random which questions to answer for the final exam. Because students' selection of Questions 4 and 5 was not guaranteed, artifact items used in the preparation of final examination Questions 4 and 5 were collected for all participants and analyzed separately from the final examination by using a specific rubric designed to analyze the frequency of public engagement actions or intentions to act. Questions were scored independently using an SM-specific grading rubric by the treatment group instructor, a third-party instructor, and the researcher (See Appendix J for Engagement

Scoring Rubric). Frequency of actions and intentions to act was measured by the choice to use SM, instances of use found in the exam artifacts, indicators of engagement, and engaging others.

Scores on Question 4 ranged from 0 to 25, and those for Question 5 ranged from 0 to 30 (a total of 55 points possible). Scores from the three scorers were then averaged to yield a per-question score for each question. These data were highly variable because of the level of detail in students' artifact documents, as well as because this single data point was collected at the end of the semester.

Index of Public Engagement Activity. A weighted index score of self-reported actions and intentions to act was calculated for each participant in the treatment and comparison groups. Data for the Index of Public Engagement Activity (IPEA) was derived from the three data sources discussed above: (a) the self-reported engagement actions on the unit-end module quizzes (50%), (b) the additional engagement actions and intention-to-act data on the attitude survey (40%) and (c) artifacts created by students in preparation for the final examination (10%).

The final (IPEA) scores were compared using an independent samples *t*-test. Because the sample size was small, the potential for issues of sensitivity was explored and a chi-squared analysis was also conducted for the IPEA and individual components of the IPEA.

Nature of Participant Facebook Experience

Interviews were conducted with 54% of participants in the treatment group ($n = 7$), 38% of participants in the comparison group ($n = 5$), and both instructors. All interviews were digitally recorded and transcribed verbatim for analysis. Interviews were analyzed for participants' views on their public engagement, Facebook experiences, navigation of technology, indicators of public engagement, and actions, using a list of theme codes derived from the literature review that focused on SM issues (social capital, identity, privacy), SM use (logistics,

convenience, friending), instruction (learning environment, support, instructor engagement, student engagement), and public engagement (actions, intentions to act, sharing information).

The emergent themes and patterns noted and analyzed included social or educational uses, dialog generation, functionality, posting, traversing classroom boundaries, and meeting participants with media they were already using.

Analysis of comparison group interview data confirmed that no dissemination of treatment took place. Further analysis of these data did not result in greater understanding of the intervention and did not provide new insights with respect to the use of Facebook. Therefore comparison group interview data will not be referenced further in the results or discussion.

Limitations

This study provides insight into the use of Facebook as an instructional tool for enhancing engagement with a specific population in a specific educational setting. Therefore, results from this study are not necessarily representative of any larger populations.

Instructional Fidelity

There was potential for an instructor effect because different instructors taught students in the treatment and comparison groups and because the treatment group instructor had an interest in using SM as an instructional component in the Course. To help ameliorate this effect, the instructional actions and strategies of both the treatment and comparison group instructors were closely monitored throughout the study. Each instructor coordinated Course activities (except for the Facebook activities) and followed stipulated protocols (a) through weekly coordination meetings to ensure that comparison group instruction closely followed existing Course procedures, processes, and materials, and (b) by adhering to scripted Course protocols and

detailed plans for implementing the Facebook intervention components in the intervention section.

During weekly meetings, the instructors discussed key content topics, discussed Course details for the coming week, and planned for upcoming instruction, laboratory sessions, field trips, and assignments. Furthermore, the computerized course-management system ensured that both instructors and their students had access to identical instructional materials. Instructors completed and submitted the SM feedback form at the end of each class period when the researcher could not attend to collect field observations (Appendix D). The SM feedback form was used to capture participants' observations and questions about SM use, classroom-based discussion about Facebook, and spontaneous Facebook use that occurred.

Diffusion of Treatment

Diffusion was another potential threat because of the nature of Facebook, which is to share information and ideas with social networks, thereby diffusing the information among participants who knew each other in the different sections. Diffusion could have occurred if students in the treatment and comparison groups shared social networks. To mitigate this threat, separate section-specific Facebook pages were set up for interaction throughout the semester, diffusion was monitored for throughout the semester, and interviews were conducted with the comparison group. No diffusion of treatment was observed.

CHAPTER 4

RESULTS

The integrated Facebook instructional component was assessed for its impact on content knowledge, attitudes toward public engagement in relation to global warming, and indicators of public engagement in a community college environmental biology course focused on environmental issues and global climate change. The intervention context is further described below using Facebook metrics and observations of general Facebook usage patterns throughout the study period. The sections below report the impact of the intervention on participants' content knowledge, attitudes, and actions or intentions to act. The nature of participants' experience with the integration of Facebook as an instructional engagement tool in the learning environment was also studied. Concluding the chapter is a discussion of participant experiences derived from interviews and classroom observations.

Participants' Device and Social Media Use

Digital Device Ownership and Access

Results in Table 8 show participant ownership and access to electronic devices. In the treatment group, all of the participants either owned or had access to (through a loan, the school, or a library) at least one to three (23%), and, in most cases, four or more (77%), electronic devices, including some combination of a desktop computer, laptop computer, smartphone, tablet or iPad, and cellular phone. Similarly, the comparison group participants owned or had access to at least one to three devices (25%) and four or more devices (75%), respectively. Chi-squared analysis showed no statistically significant differences in ownership or access between the two groups.

Table 8

Participants' Electronic Device Ownership or Access

Device(s)	Treatment		Comparison		χ^2
	<i>n</i>	%	<i>n</i>	%	
Single device					
Desktop computer	12	92.3	11	91.7	0.953
Laptop computer	12	92.3	11	91.7	0.953
Tablet or iPad	9	69.2	8	66.7	0.891
Smartphone	11	84.6	10	83.3	0.930
Cellular phone	13	100.0	11	91.7	0.288
Multiple devices					
1 to 3	3	23.1	3	25.0	0.910
≥4	10	76.9	9	75.0	0.910

The results demonstrate that both groups had similar access to electronic and digital devices from which to access SM. Thus, it can be concluded that digital device ownership and access were not a factor in ability to participate in, or benefit from, the Course or the intervention. Furthermore, these data demonstrate that any differences measured between treatment and comparison group are not related to differences in digital device access among participants.

Initial Social Media Use Among Participants

Table 9 shows results for participant communication and SM usage preferences. Participants in both groups reported using e-mail, text messaging, and social network sites

“often” to “very often.” In both groups, limited use to no use of blogs and Twitter was also common. A widespread distribution of YouTube use was reported. Chi-squared analysis showed no statistically significant difference between the two groups.

The results show no significant between group differences in media and SM use between the treatment and comparison groups. Use of social networking sites was widespread in both groups as expected. These data also confirm that participants were equally familiar with the types and availability of SM. Neither group used one form of media preferentially over another. No significantly statistical differences were found between the two groups in SM use or preferences. Thus, it can be concluded that any gains measured in the treatment group’s performance are not the result of initial differences in media use preferences.

Facebook Use Statistics for the Treatment and Comparison Groups

Table 10 shows a summary of weekly statistics for posts, *likes*, and visits. Posts, which represent specific participant actions and engagement on the Facebook page, were substantially higher for the treatment group. Weekly reported data for *likes* and visits were comparable, but determined to be less reflective as indicators for engagement on the Facebook page, as discussed below in each specific section.

Wall posts. The number of posts on the treatment group Facebook page was greater than the comparison group page, and the difference was statistically significant ($p < .0005$). Post totals are shown in Table 10, as reported by Facebook. The treatment group, which was required to use Facebook, ranged from 3 to 43 posts during any given week and the total number of posts reported over the 16-week intervention was 269. All posts were directly related to course content and assignments with no unrelated posting observed. The treatment group totals reflect both instructor and participant posts.

Table 9

Participants' Communication and Social Media Use

Media	Infrequent				Frequent				χ^2
	Treatment		Comparison		Treatment		Comparison		
	<i>n</i>	% total	<i>n</i>	% total	<i>n</i>	% total	<i>n</i>	% total	
E-mail	4	31	1	10	9	69	9	90	.231
Text Messaging	1	8	1	10	12	92	9	90	.846
Social Network Sites	0	0	2	20	12	92	8	80	.385
Blogs	13	100	7	70	0	0	3	30	.092
Twitter	9	69	8	80	4	31	2	20	.560
YouTube	7	54	3	30	6	46	7	70	.253

Table 10

Metrics Reported by Facebook

Week	Posts		Visits		Likes	
	T	C	T	C	T	C
Measurement results						
Week 1	23	0	n/a	n/a	n/a	n/a
Week 2	10	2	60	n/a	30	n/a
Week 3	3	3	32	n/a	30	n/a
Week 4	38	4	46	49 ^a	30	37
Week 5	33	0	88	38	31	37
Week 6	17	1	75	20	34	37
Week 7	6	1	100	23	36	37
Week 8	10	1	98	12	37	37
Week 9	43	0	104	5	37	37
Week 10	5	0	29	17	37	39
Week 11	0	0	61	34	37	39
Week 12	10	1	38	18	37	39
Week 13	10	2	n/a	n/a	n/a	n/a
Week 14	36	1	52	18	38	39
Week 15	20	2	77	72	40	40
Week 16	5	1	65	42	40	40
Total	269	19				
Statistical results						
<i>M</i>	16.8**	1.2	66.1**	29	35.3	38.2*
<i>SD</i>	13.82	1.13	25.23	18.81	3.63	1.27

Note. T = treatment group; C = control group; NA = data unavailable from Facebook.

^aWeek 4 visit data were corrected for personal activities of the comparison group instructor (see text for description).

* $p < .05$. ** $p < .0005$.

For the comparison group, posting activity was all conducted by the instructor and ranged from 0 to 4 posts weekly with a total of 19 posts for the semester. No student posts were observed from the comparison group.

Results in Table 11 show a summary of the Facebook posting types used to initiate communication interactions in the treatment group. Table 11 does not include posts by external experts, the researcher, or other non-participants ($n = 31$). Posts by the comparison group instructor, not shown here, were all to provide informational articles or links.

Posts by the treatment group instructor consisted primarily of comments, articles, and links to information or websites. Logistical postings, such as videos and maps for field trips, were the next most common posts. More than 50% of postings by treatment group participants were comments. Articles and videos were posted primarily for Course assignments.

Table 11

Facebook Postings by Type for Instructor and Participants in Treatment Group

Posting types	Treatment instructor		Treatment participant	
	Items	% Total	Items	% Total
Comments	21	28.8	86	52.1
Articles	19	26.0	37	22.4
Links	15	20.5	6	3.6
Videos	5	6.8	30	18.2
Maps	5	6.8	0	0.0
Survey	4	5.5	0	0.0
Other	2	2.7	6	3.6
Game	2	2.7	0	0.0
Total	73	100.0	165	100.0

Figures 4 and 5 show the total number of participant and instructor posts, respectively, for the treatment and comparison groups mapped onto the Course assignments. Participants in the treatment group used Facebook throughout the semester, whereas participants in the comparison group did not make any Facebook posts at all throughout the entire semester.

The Facebook use of participants in the treatment group peaked between Weeks 4 and 9, with a spike in Weeks 14 and 15. Peak Facebook use in the treatment group directly reflected class assignments requiring posting in response to two classmates' posts in Weeks 5, 9, and 14. Class periods in which Facebook was used for instruction also showed high numbers of posts. By contrast, posts by the comparison group instructor, although consistent, were limited in number throughout the semester. No participants in the comparison group posted during the semester.

Results show that the treatment group demonstrated substantial use of Facebook during the intervention. A direct connection between highest number of posts and assignments requiring posts was seen indicating that treatment group participants used Facebook primarily to fulfill Course requirements as can be seen during weeks of peak Facebook use. Thus, it can be concluded that Course requirements drove Facebook use. Additionally, because no such results were observed for the comparison group, it might further be concluded that without specific purpose and assignment Facebook would likely not have been used: Results would have reflected Facebook use for the intervention group that would have been similar to that observed in the comparison group.

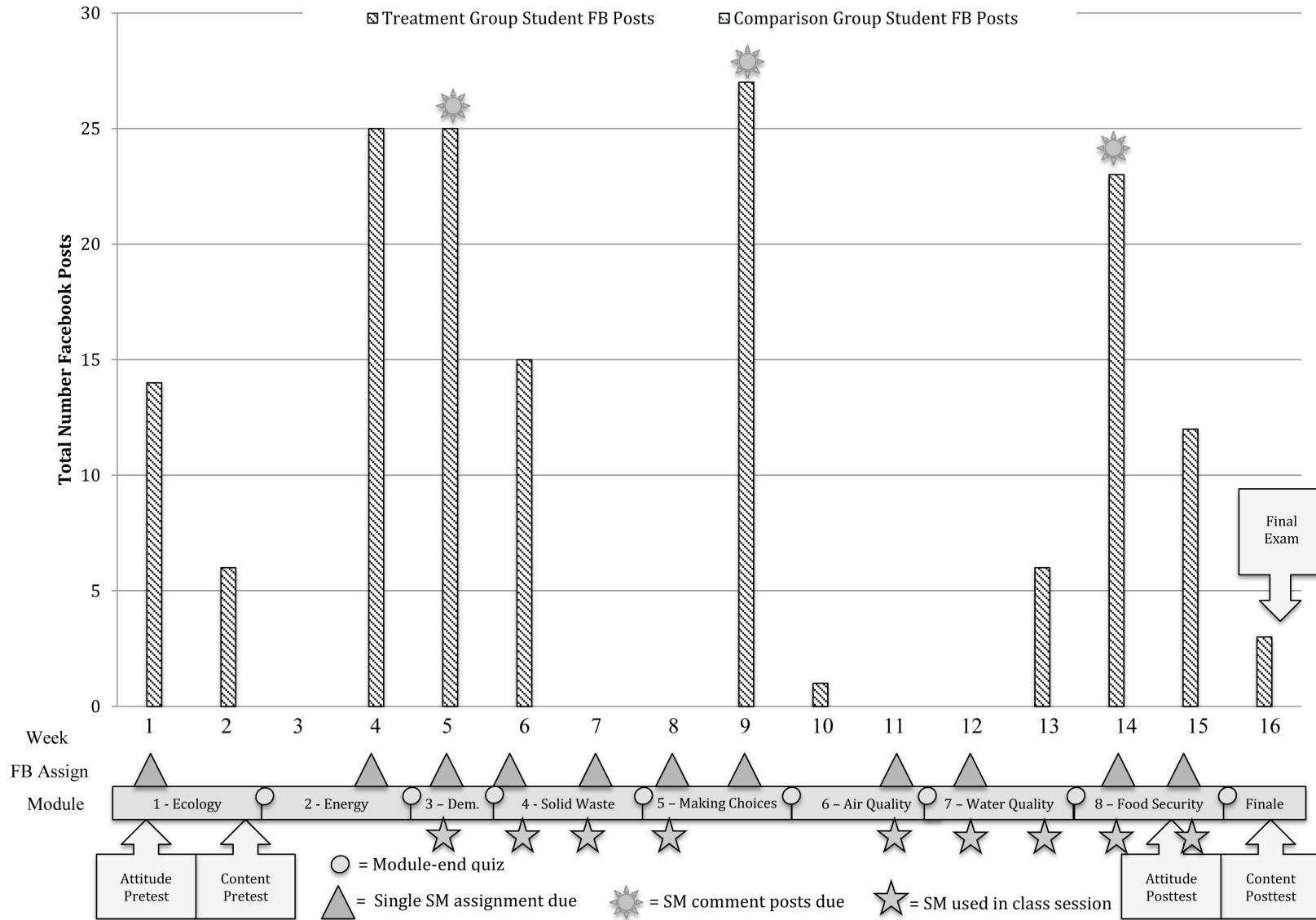


Figure 4. Facebook (FB) activity for students tracked weekly by group.

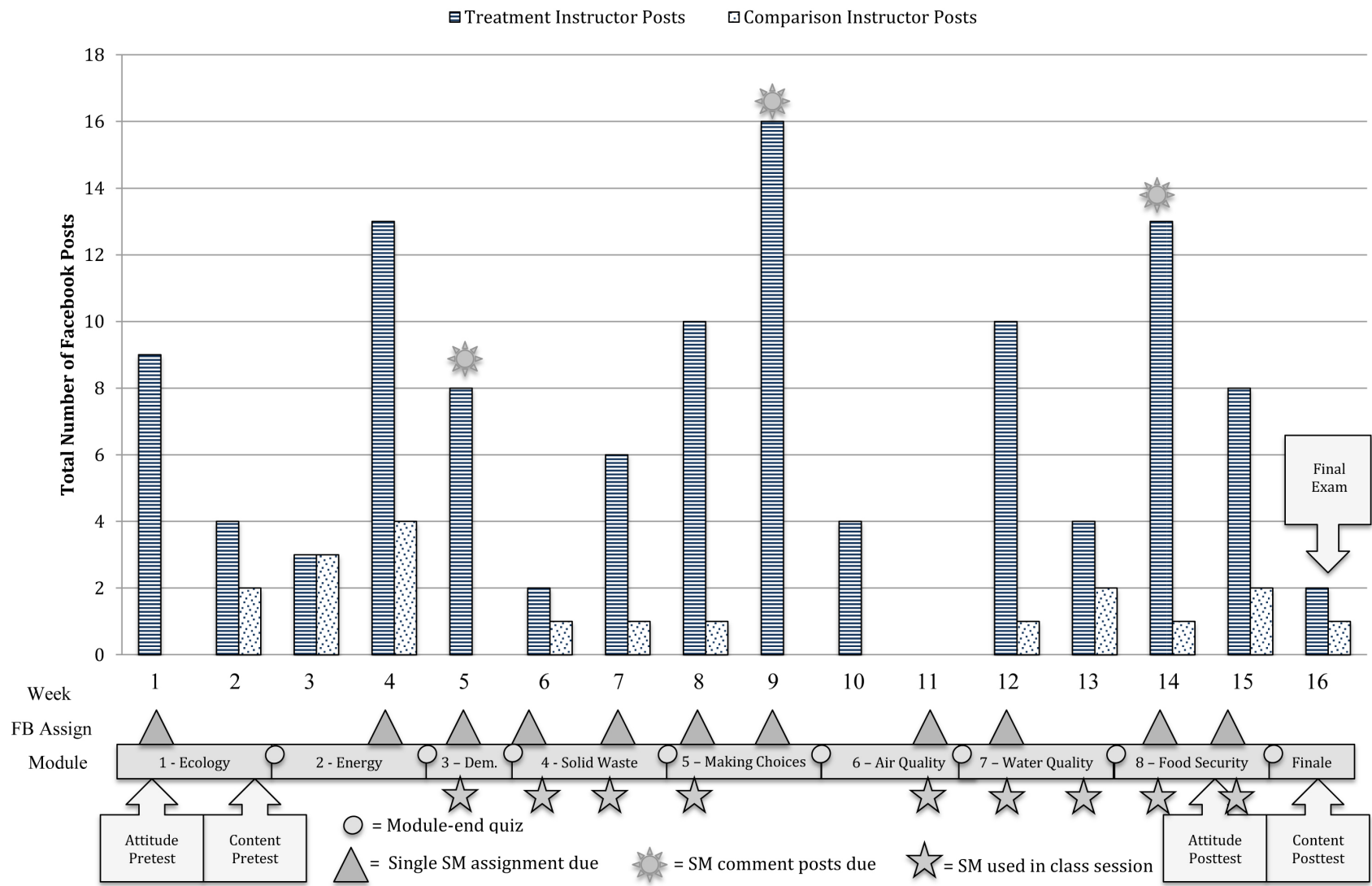


Figure 5. Facebook (FB) activity for instructors tracked weekly by group.

People who liked the page. Results for people who *liked* the Facebook pages are shown in Table 10. Results show *likes* proceeded along a predictable pattern with high initial activity, which leveled off during the semester. The number of people who *like* the page increased immediately at the beginning of the semester when participants in the treatment and comparison groups joined their respective Facebook pages. The number of *likes* then leveled off as no new participants joined the page. The number of *likes* remained relatively constant throughout the semester for both groups, indicating that few, if any, new followers joined after the initial activity by participants, instructors, other followers, and the researcher early in the semester.

A statistically significant difference between the comparison and treatment group for *likes* was found ($p < .05$). However, although these data show a statistically greater number of *likes* for the comparison group, when data are corrected for the unusually high number of personal contacts by the comparison group instructor, the observed difference would disappear.

Looking beyond the Facebook-provided data to the actual participation on the Facebook page gave additional insight into who *liked* each page and how they were related to the study. For both groups, there were more *likes* than number of students. Two groups dominated the Facebook user distribution for the treatment group: (a) study participants (65%) and (b) professional contacts of the instructor, including the instructor (21%) and the researcher. Four unknown persons (12%) *liked* the Facebook page of the treatment group. In contrast, the user distribution for the comparison group page was dominated by personal instructor contacts (53%), followed by study participants (21%), and unknown users (16%).

Thus, it may be concluded that *likes* as a data source may not accurately reflect the level of activity on any given Facebook page. Indeed, upon closer examination on a person-by-person basis the number of *likes* was highly variable and as a single measurement was misleading.

Site visits. Results for the number of visits made to the Course Facebook page are shown in Table 10. The number of visits for the treatment group ranged from 29 (Week 10) to 104 (Week 9), whereas the number for the comparison group ranged from 5 (Week 9) to 49 (Week 4). Members of the treatment group made a larger number of visits to their Facebook page than the comparison group, and the difference was statistically significant ($p < .0005$).

Although significant differences were found, the number of visits was difficult to attribute to specific groups (i.e., participants, random users, instructors, or other visitors) or activity undertaken once on the Facebook page. For example, one would expect that, given the number of visits recorded by the comparison group, there was some activity among study participants and yet, no posts were made by comparison group participants as can be seen in the wall post column.

The nature of what a visit to the Facebook page entailed was difficult to determine because any time anyone inside or outside of the study visited a page it was recorded. For example, each time the researcher or instructor went to the page to record data and review posts, the activity counted as a visit. The number of visits may, on the other hand, give insight into passive participation as noted by some students, which is discussed in greater detail in the interview section below. Again, it could be concluded that as a sole measurement of activity or use, site visits did not provide detailed enough information about what constituted a visit. However, when considered in conjunction with other data such as wall posts, the number of visits help to triangulate the potential impact of post results. Thus, from visit data, it could only be determined that the treatment group did in fact visit their Facebook page with statistically greater frequency than the comparison group indicating that their Facebook use was greater, but not what the nature of the visits were.

Social Media Use Index

Tables 12 show results for the calculated SM Index for participants in the treatment group. A wide range of SM Use Indices was observed for the treatment group members, ranging from 0 to 59, indicating use level varied among participants. The researcher's classroom and Facebook observations corroborated results for SM Use Index and participants with highest Facebook activity were correlated with those having the highest SM Use Index. In other words, the most active participants in classroom discussion and activities, and on Facebook also had the highest SM Use Index.

The treatment group data show that participants favored simple interactions and single posts. Unidirectional posts, such as a participant posting a video link, were the most common type of postings ($n = 96$). Bidirectional posts, involving one-to-one communication, were less common ($n = 59$) but were reasonably frequent, likely because of the requirement in certain assignments to post in response to a classmate's comments. However, there were very few ($n = 4$) multidirectional exchanges of posts and only among those students with the highest SM Use Indices. In comparison, the SM Use Indices for members of the comparison group were all equal to zero because these participants did not conduct any Facebook posting activity.

Results show that considerable use of Facebook occurred in the treatment group during the intervention. It is important to note that the interactions among students were primarily limited to uni- and bi-directional exchanges and multi-threaded post exchanges were rare. In contrast, the SM Use Indices for the comparison group show no SM use occurred as a result of the optional Facebook page. Thus, it can be concluded that the Facebook intervention did have a substantial impact on participant Facebook usage, although it did not result in extensive interactivity or dialog as expected by the instructor.

Table 12

Social Media Use Index Results for Treatment Group Participants

Participant	<i>N</i> unidrxnl	<i>N</i> bidirxnl	<i>N</i> multidrxnl	Uscore	Bscore	Mscore	SM Index
Scoring based on instances of public engagement activities							
01-002	5	5	0	5	15	0	20
01-003	14	9	1	14	27	5	46
01-004	10	9	1	10	27	5	42
01-005	10	5	0	10	15	0	25
01-007	6	4	0	6	12	0	18
01-008	9	1	0	9	3	0	12
01-013	2	3	0	2	9	0	11
01-014	12	14	1	12	42	5	59
01-015	9	2	0	9	6	0	15
01-016	0	0	0	0	0	0	0
01-017	9	5	0	9	15	0	24
01-018	7	1	0	7	3	0	10
01-020	3	1	1	3	3	5	11
Statistical analysis of public engagement activities							
<i>M</i>	7.38	4.54	0.31	7.38	13.62	1.54	22.54
<i>SD</i>	3.89	3.90	0.46	3.89	11.69	2.31	16.16

Impacts on Participants' Content Knowledge

Treatment and Comparison Group Pretest Comparison

Table 13 shows the mean content knowledge pretest scores by group for the 30-item instrument and the separate 8-item pretest about global climate change. An independent samples *t*-test showed no statistically significant differences between mean pretest scores of the treatment and comparison groups ($p < .05$). An additional independent samples *t*-test showed no statistically significant differences on the eight specific climate change questions between the treatment and the comparison groups ($p < .05$). Thus, from the pretest comparison, it can be concluded that there were no differences in prior knowledge between the two groups prior to the intervention.

Table 13

Content Knowledge Pretest Results for Treatment and Comparison Groups

Instrument	Treatment			Comparison			df	t(df)	p	95% CI	
	M	SD	n	M	SD	n				LL	UL
30-item pretest	19.20	4.99	12	20.00	5.91	10	20	-0.359	0.723	-5.67	4.00
8-item climate pretest	3.83	1.64	12	4.40	1.41	10	20	-0.876	0.391	-1.95	0.80

Treatment Group Pretest and Posttest Comparison

Statistically significant gains in content knowledge were observed in the treatment group. Table 14 shows the mean content knowledge pretest and posttest scores for the 30-item and 8-item content knowledge tests. A paired-samples *t*-test for the 30-item general content knowledge test showed statistically significant content knowledge gains for the treatment group ($p < .005$). A mean increase of 3.80-points out of 30 points representing a gain of 13% in content knowledge

was measured. Gains occurred specifically in questions related to the areas of sustainability concepts, environmental human impact, ecological concepts, and air pollution.

Table 14

Content Knowledge Pretest–Posttest Results for Treatment Group

Treatment	Pretest		Posttest		n	df	t(df)	p	95% CI	
	M	SD	M	SD					LL	UL
30 Items	18.50	5.19	22.30	6.20	10	9	4.67	0.001*	1.959	5.641
8 Items	3.71	1.65	4.44	1.20	10	9	1.67	0.129	-0.258	1.716

A paired-samples *t*-test for the global climate change specific items show that there was not a statistically significant gain in this area. However, as can be seen in Table 14, a 0.73-point increase out of 8-points gain was measured between the pretest and posttest on the 8-item global climate change specific instrument, representing a 9% gain in content knowledge about global climate change.

The results for treatment group pretest–posttest comparison indicate statistically significant gains in general knowledge and some gain in global climate change knowledge. Thus, it can be concluded that content knowledge was impacted by instruction. However, in order to determine if the impact was realized as a result of the Facebook intervention, the treatment and comparison groups must be compared. Because of the absence of comparison group posttest results, it could not directly be determined if the intervention had an impact on content knowledge gains. Therefore, a comparison between the treatment group and a matched comparison sample taught by the treatment group instructor during a previous semester was used as a proxy comparison group to further understand the observed gains in knowledge. The results are discussed in the next section.

Treatment Group and Matched Comparison Pretest and Posttest

The results for the treatment group and matched comparison group pretest–posttest content knowledge tests are shown in Table 15. A one-way ANOVA showed no statistically significant differences between pretest and posttest scores for the treatment group and the matched comparison group.

Table 15

Content Knowledge Comparison for Treatment and Matched-Sample Groups

Treatment (Fall 2011)			Matched Comparison (Fall 2010)									
30-item Difference			95% CI		30-item Difference			95% CI				
<i>M</i>	<i>SD</i>	<i>n</i>	<i>LL</i>	<i>UL</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>LL</i>	<i>UL</i>	<i>df</i>	<i>t(df)</i>	<i>p</i>
3.80	2.57	10	1.95	5.64	2.63	1.19	9	1.85	4.31	1	1.18	0.292

Results indicate gains in content knowledge for the treatment group were similar to gains in previous years. Both groups increased in content knowledge to a similar extent, not showing any advantage for those who had a Facebook component. Thus, it can be concluded that content knowledge gains measured during this study are the result of instruction and not the intervention.

Summary of Content Knowledge Analyses

In summary, results from the treatment and comparison group pretests showed no statistical difference between groups at the beginning of the study. Results from the treatment group pretest–posttest indicate that there was a statistically significant difference in content knowledge tests between the beginning and end of the study. However, results from the treatment group and a matched comparison group sample showed no statistically significant difference in content knowledge gains. Thus, it can be concluded that gains measured in content knowledge were the result of Course instruction and not of the Facebook intervention.

Impacts on Participants' Attitudes About Climate Change

Results for the study participants' mean attitude pretest and posttest scores are shown in Table 16. Results for the treatment group show they experienced a negative shift from between Cautious ($M = 3.38$) to Concerned ($M = 2.77$), representing a more concerned (and desirable) stance toward global warming. Results for the comparison group show they experienced a positive shift (in the opposite direction as the treatment group) from Concerned ($M = 2.10$) to Cautious ($M = 3.00$), representing a more disengaged stance about global warming.

A one-tailed Wilcoxon signed-rank test showed a statistically significant negative shift in the treatment group attitudes between the pretest and posttest ($p < .05$). Negative shifts occurred in 46% of participants ($n = 6$), meaning that these participants moved from a higher rank to a lower rank, indicating increased concern. No shift occurred, meaning the same attitude persisted, for 46% of participants ($n = 6$) between the pretest and posttest. Positive shifts occurred in 7% of participants ($n = 1$), meaning that this one participant moved from a lower rank to a higher rank, indicating decreased concern. These data show specific shifts by individual and account for all changes in attitude within the group.

A one-tailed Wilcoxon signed-rank test showed a statistically significant positive shift in the comparison group attitudes between the pretest and posttest ($p < .05$). Positive shifts occurred in 50% of participants ($n = 5$), meaning that these participants moved from a lower rank to a higher, indicating disengagement or less concern. No shift occurred, meaning the attitude persisted, for 40% of participants ($n = 4$). Negative shifts occurred in 10% of participants ($n = 1$), meaning that this participant moved from a higher rank to a lower rank, indicating increased concern. These data show specific shifts by individual and account for all changes in attitude within the group.

Table 16

Comparison of Treatment and Comparison Group Attitudes

Data	Group	Pretest	Posttest	Posttest-pretest	Statistical analysis
		Counts			
<i>n</i>	Treatment	13	13		
	Comparison	10	10		
		Statistical analysis			
<i>Mean</i>	Treatment	3.38	2.77	-0.61	
	Comparison	2.10	3.00	0.90	
<i>SD</i>	Treatment	1.66	1.54		
	Comparison	0.74	1.56		
<i>Median</i>	Treatment	3.00	2.00	-1.00	
	Comparison	2.00	2.50	0.50	
<i>z</i>	Treatment				-1.930
	Comparison				1.725
<i>p</i>	Treatment				0.027*
	Comparison				0.042*

Note. Attitudes about global climate change were characterized along a continuum ranging from Alarmed to Dismissive, where Alarmed = 1, Concerned = 2, Cautious = 3, Disengaged = 4, Doubtful = 5, and Dismissive = 6. Therefore, a negative shift in the mean indicates more concern about global warming, whereas a positive shift in the mean indicates more disengagement in the subject. z = Wilcoxon signed-rank.

* $p < .05$, one-tailed.

In summary, results showed a statistically significant difference in attitude among treatment group participants who either maintained their original attitude or experienced a shift in attitude toward more concern about global climate change. Results showed a statistically significant difference in attitude among the comparison group participants who either maintained their original attitude or experienced a shift in attitude toward less concern about global climate change. Participants in the treatment group who used Facebook stayed engaged or became more concerned about the issue of global climate change. In contrast, the comparison group moved from initially being more concerned than the treatment group to less engaged overall. Thus, it can be concluded that the intervention using Facebook had an impact on treatment group participant attitudes, which helped to keep them engaged throughout the study and increased their concern about the issue of global climate change.

Impacts on Participants' Engagement Actions and Intention to Act

The results for self-reported items of engagement action and intention to act are presented in four parts. Results shown in the first through third sections are the component data used to measure engagement actions and intentions to act. The fourth section presents data for the Index of Public Engagement Activity (IPEA) composite index of all engagement activity measured.

Engagement self-report actions from module-end quizzes. Results in Figure 6 show the total number of self-reported actions by participants. The treatment group reported more than twice as many module-end engagement actions during the intervention than did the comparison group, $n = 261$ and $n = 123$, respectively.

Participant	Write letter to editor	Write to Congress	Sign a petition	Make different shopping choices	Discuss with friends & family	Volunteer	Seek additional info	Use SM to share info	Use traditional media to share info	Reduce impact	Total by participant
Treatment Group											
01-002	2	2	2	7	6	2	7	4	3	6	41
01-003	0	0	0	2	7	0	6	4	0	3	22
01-004	0	0	0	2	8	0	6	7	3	3	29
01-005	0	0	0	8	8	1	4	7	6	7	41
01-007	0	0	0	0	5	3	1	2	1	5	17
01-008	1	2	2	4	5	1	6	6	4	2	33
01-013	0	0	0	0	2	0	1	6	2	2	13
01-014	0	0	0	1	1	0	0	2	2	0	6
01-016	0	0	0	0	1	0	0	6	0	0	7
01-107	0	0	0	2	5	0	0	0	1	6	14
01-018	0	0	0	2	5	0	0	0	0	1	8
01-020	0	0	0	0	3	0	0	2	0	3	8
Total by Action	3	4	10	29	62	7	34	50	22	40	261
Total %	1	2	4	11	24	3	13	19	8	15	100
Comparison Group											
02-002	0	0	0	0	2	0	1	0	0	1	4
02-003	0	0	0	4	6	0	1	1	1	3	16
02-004	0	0	0	1	2	1	0	0	0	3	7
02-005	0	0	0	1	3	0	3	0	0	3	10
02-006	0	0	0	2	0	1	1	1	1	7	13
02-007	0	0	0	0	0	0	0	0	0	0	0
02-008	0	0	0	1	2	0	0	0	0	3	6
02-009	0	0	0	0	5	1	6	0	0	4	16
02-010	0	0	0	3	4	0	0	0	0	7	14
02-011	0	0	0	0	0	0	0	0	0	0	0
02-012	0	0	0	3	4	0	0	0	0	7	14
02-013	0	0	0	7	6	0	2	2	0	6	23
Total by Action	0	0	0	22	34	3	14	4	2	44	123
Total %	0	0	0	18	28	2	11	3	2	36	100

Figure 6. Summary of self-reported actions.

Figure 7 shows comparative results for self-reported engagement actions. The most commonly reported engagement actions for treatment group participants were discussions with friends and family (24% of all actions), sharing information using SM (19% of all actions), and reducing their impact by actions such as recycling (15% of all actions). Some treatment group participants also engaged in activities that went beyond their personal influence by signing petitions (4% of all actions) and writing letters to members of Congress or editors (1–2% of all actions, respectively). Comparison group participants reported reducing their impact most frequently by actions such as recycling (36% of all actions), discussions with friends and family (28% of all actions), making different shopping choices (18% of all actions), and seeking more information (11% of all actions).

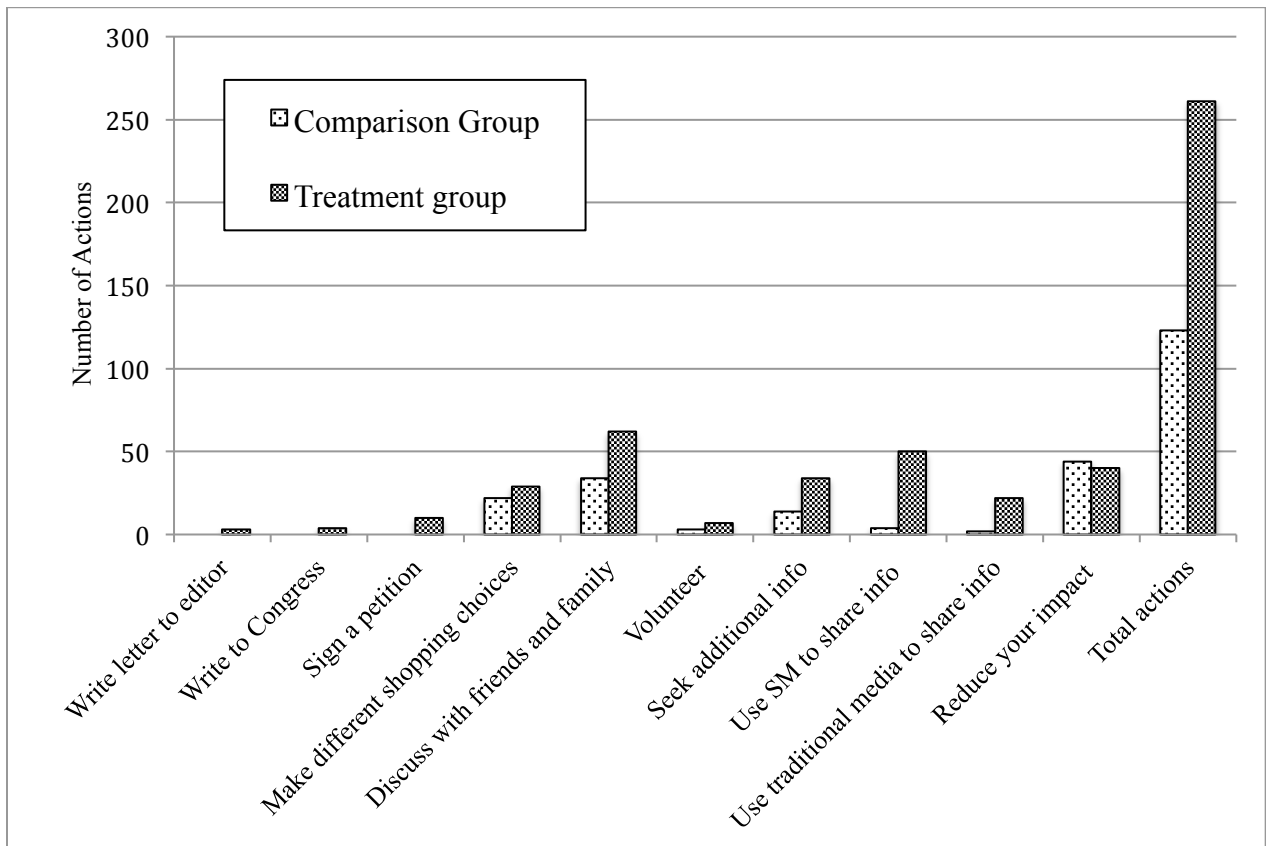


Figure 7. Comparison of self-reported engagement actions by group. SM = social media.

Also of note is that the treatment group was four times more likely to use SM as a form of action than the comparison group. Overall both groups indicated willingness to engage in lower impact activities, such as sharing information with family and friends (either with SM or using traditional means) over higher impact activities such as writing letters or signing petitions.

The results demonstrate a considerably higher level of actions and intentions to act by the treatment group. Thus, it can be concluded that the high level of engagement expressed by the treatment group is an indication of the effectiveness of the Facebook intervention on the willingness to engage in public participation activities.

Self-reported actions and intentions to act from the attitude survey. Results in Table 17 show self-reported actions taken in the past 12 months and intend to take in the next 12 months regarding global climate change. The treatment group participants were more engaged in taking action with respect to the subject of global climate change than were participants in the comparison group. Participants in the treatment group indicated more intentions to act ($n = 103$) overall than did those in the comparison group ($n = 75$). Results show greater number of overall actions and intentions to act by the treatment group indicating the intervention had an impact on participant actions.

Table 17

Summary of Self-Reported Engagement Actions from Attitude Survey

Item	Treatment			Comparison		
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>
Over the past 12 months, how many times have you . . . ?						
Volunteered or donated money to an organization working to reduce GW	5	0.38	0.49	2	0.20	0.40
Posted a comment online in response to a news story or blog about GW	22	1.69	1.86	4	0.40	0.49
Written letters, e-mails, or SM posts, or phoned government officials about GW	10	0.77	1.31	2	0.20	0.40
Total	37	2.85	2.74	8	0.80	0.98
Over the next 12 months, would you like to do the following?						
Volunteer or donate money to an organization working to reduce GW	36	2.77	2.08	29	2.90	2.12
Post a comment online in response to a news story or blog about GW	36	2.77	2.08	25	2.50	2.06
Write letters, e-mails, or SM posts, or phone government officials about GW	31	2.38	2.10	21	2.10	1.92
Total	103	7.92	5.81	75	7.50	5.04

Note. GW = global warming. *n* is based on responses to a Likert scale, where *a lot* (>4) = 5,

Indicators of public engagement from the final oral examination. Table 18 shows treatment and comparison group mean scores from the scored final examination artifacts. The treatment group had greater mean scores on the personal action plan ($M = 5$, $SD = 1.93$) and the environmental advocacy plan ($M = 11$, $SD = 1.77$) than did the comparison group.

Table 18

Summary of Final Examination Scores for Questions 4 and 5

Question	Treatment		Comparison	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Personal Action Plan	5	1.93	1	7.28
Environmental Advocacy Plan	11	1.77	8	8.20

Index of Public Engagement Activity. Results in Table 19 show the mean overall IPEA scores by group. The IPEA scores for the treatment group ranged from 5 to 31 ($M=15.08$, $SD=8.48$), whereas those for the comparison group ranged from 3 to 18 ($M=10.10$, $SD=3.12$). An independent samples *t*-test showed no statistically significant differences between the treatment and comparison groups for either the IPEA or the individual IPEA component scores (discussed above). A chi-squared analysis also showed no significant relationship between the two groups. However, the treatment group did have considerably higher IPEAs and greater mean values for each of the component measures within the IPEA. Thus, it can be concluded that the participants in the Facebook intervention acted more frequently and/or expressed more intentions to act than the comparison group. The considerable differences for IPEA and component measures can be attributed to the use of Facebook in the intervention.

Table 19

Participants' Index of Public Engagement Activity (IPEA)

Variable	Treatment		Comparison		df	<i>t</i> (df)	<i>p</i>	95 CI		<i>X</i> ²
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				<i>LL</i>	<i>UL</i>	
IPEA	15.08	8.48	10.10	4.15	18.27	1.85	.081	-0.68	10.63	.305
Module Actions	20.08	12.54	12.80	6.05	18.15	1.83	.083	-1.06	15.61	.099
GW Actions	10.77	7.83	8.30	5.42	21.00	0.85	.405	-3.57	8.51	.510
Exam Actions	15.15	8.38	9.20	9.37	21.00	1.61	.123	-1.76	13.67	.510

Note. GW = global warming.

Perceptions of Facebook in the Learning Environment

Facebook use in the learning environment is discussed along with participants' perceptions of SM. Facebook use impacted participants' learning experiences in four major areas: (a) *convenience and logistics*, (b) *community and communication*, (c) *engaging learning environment*, and (d) *alternative participation pathways*. The results are presented by theme with a definition followed by examples. All interview results reported are for the treatment group and all names are pseudonyms.

Use of Facebook with Time

Although participants adapted to Facebook use and the integrated component quickly, the idea of using Facebook in the educational environment was initially reported as being awkward by 43% of treatment group participants interviewed ($n = 3$). However, increased exposure resulted in more natural use with time, and all participants who commented on the challenges ($n = 3$) of adapting to Facebook said this awkwardness diminished early in the semester.

In other words, Facebook use became more natural over time in the learning environment. It took time for both the instructor and the treatment group participants to fully implement Facebook use in the educational setting. At the beginning of the semester, treatment group participants were uncertain how Facebook would be used, and all those interviewed expressed mixed impressions, ranging from positive to skeptical, about using Facebook as a classroom engagement tool. Although only one interviewee specifically mentioned privacy as a concern, 43% of the participants interviewed ($n = 3$) were concerned that using Facebook would “ruin Facebook” by blurring the line between their social and educational uses. One example from Matt illustrates this change in thinking that occurred as he became more familiar with how the instructor was using Facebook:

I was thinking [there would be] a lot of homework that would trash my idea of Facebook. I will not want to get on there because I will think about school. I do not think it went badly. It was separate because I had to type in [the course name] to see the page. I did not have to think about school until I ran that search. When I got there, I could cruise around, see what people are saying, see how I can respond, see what [the instructor] has to say, or what is due.

Convenience and Logistics

The *convenience and logistics* theme is defined as the ways in which the instructor and participants used Facebook in the intervention. Facebook uses included in this theme were posting reminders, posting maps, and discussing assignment details. Facebook convenience factors, such as providing multiple access points to complete assignments and using a platform for communication already familiar to students, was the primary focus of this theme.

Facebook use was convenient. All the treatment group participants interviewed stated that using Facebook was convenient for communication because it was a platform they already knew how to use. Chrissy commented, “It was pretty easy because we are all familiar with it. It is something we are comfortable with.” In other words, participants were already using Facebook to communicate, were often on Facebook for social reasons, and could use the Course Facebook page to complete classroom assignments easily. Facebook provided a convenient and accessible platform that allowed for multiple access points through electronic devices such as desktop computers, tablets, and smartphones. As Kerry said, “Everyone has a Facebook.”

Another convenience noted by all participants interviewed was having a quick mechanism for communicating:

If I had e-mailed [the instructor] about something that needed an immediate response, like changing my final time beforehand, I would write on her Facebook, “I e-mailed you, just in case you haven’t seen it.” Or, I would get on my phone and write on the Facebook wall. (Sandy)

There were two or three other athletes in the class. We would use Facebook to find out [about assignments]. You just post a question and they tell you, which made it even easier because I don't see them much outside of school. (Jim)

In addition, the treatment group instructor enjoyed the flexibility Facebook afforded during the semester: “the nature of the ability to be flexible and post on this or that, so it was not necessarily planned, but it was an important integrated component.”

The ability to complete homework assignments while sitting at baseball practice or shortly before class, wherever students were, was cited as an example of convenience by 71% of treatment group participants interviewed ($n=5$). Matt commented, “[I enjoyed] how handy it was. I get on Facebook fairly often. I can get it on my laptop or here at the school, anywhere I want.”

Facebook use facilitated logistics. Facebook was also useful for delivering Course logistics. It helped students remember field trips and course assignments or query their fellow classmates for information about assignments. All the treatment group participants interviewed commented that posting maps and logistics helped keep them on track and helped them find their way: “It was a helpful reminder to say I might be having a field trip that day, and I would get on in the morning and see, okay, we do have a field trip” (Matt). The treatment group instructor also noted that it was “easier to do certain things like post maps for field trips and reminders to the students.”

Facebook helped students keep track of Course requirements and rapid changes in the schedule. For example, Sandy noted, “One day we did not have class and [the instructor] has us post our [assignment] on Facebook. That was really nice. Facebook definitely came in handy on that day.” Other examples highlighted how Facebook aided participants in remembering Course details and how using Facebook supported the instructional goal of sustainability:

It is a lot better than turning in another sheet of paper. You don't have to print it out. And with an e-mail, you don't know exactly if it was sent, but with that post, I can see it sitting there and know that it's sent. (Matt)

Community and Communication

The *community and communication* theme is defined as who used Facebook and the effect using Facebook had on instructor and student communication and the classroom community. This theme explored areas such as creating dialog, extending classroom discussion beyond the classroom, accessing the instructor, and interpersonal connections among participants.

Facebook use built community. Facebook use facilitated community development in the learning environment. All of the participants interviewed noted that using Facebook in the Course gave them an increased sense of connection with classmates and the instructor. The *friend* function in Facebook created opportunities for connection among classmates:

I became *friends* with two people in class on Facebook. We would remind each other about posts or talk about them in class. We were more open about discussion than we would have been if it was not related to Facebook, I think. (Chrissy)

All participants viewed exchange through Facebook as a positive way to interact with the instructor, receive feedback, and generate discussion. Participants also commented on a sense of informal access to the instructor. The responsiveness of the instructor added to the sense of community students experienced:

[The instructor] made it a point to comment on our posts, make us think deeper about them. It was definitely good because it helped initiate the discussion, but she was also involved in it at the same time. (Lori)

The treatment group instructor noted an increased sense of engagement with the students, and noted that engagement started earlier in the semester than usual:

I was much more engaged with them the whole semester. They were talkers, but even the shy students were totally engaged. In the past, a few really motivated students have come

to me with content like news articles, which get dropped or talked about in class really quickly. The Facebook page allowed students to have more of a way for us to address something in class.

Facebook use supported communication. Having Facebook as an additional means by which students communicated with each other and with the instructor facilitated dialog. As Matt pointed out, the ability to communicate with the entire class, not just the instructor, opened communication, which benefitted the entire class:

I think it opened the door to communicate with everyone because [traditionally] I could send [the instructor] an e-mail through [the course-management system] and only she can respond. But if I set it up on Facebook, you can respond, she can respond, any of the class can respond.

Facebook supported a more casual way for students to engage with each other, the instructor, and the content, as Matt stated: “Facebook is the quick option. Click in, click out.” Jane noted the expansive quality Facebook communication brought to the Course: “You got to see what everyone else in the class was thinking. It was not like you were just doing your own work. It was really a discussion-based class, and I like that a lot.”

Although a sense of connectedness and community was achieved, little extended dialogue was observed on the Facebook page. The instructor, Matt, and Chrissy all expressed disappointment that more dialog was not achieved during the intervention. However, 71% of participants interviewed ($n = 5$) were content with the short and simple forms of communication possible with Facebook.

Facebook exchanges focused on classroom assignments and rarely moved from participants’ educational Facebook world to personal Facebook use. Indeed, very little communication extended beyond the Course section with 43% of all treatment group interviewees ($n = 3$) reporting that they reposted content from the Course Facebook page to their personal Facebook pages.

Engaging Learning Environment

The *engaging learning environment* theme is defined as the aspects of Facebook use that the participants reported as having influenced their engagement with the learning environment, such as participants' contribution to course content, increases in their interaction with course content, the quality of their posts and competition in posting, and the relevance of the Facebook content posted.

Contributing content. Contributing content to the Course through Facebook took multiple forms, such as by supplementing classroom discussion topics by seeking out and posting content that students found to be connected to their areas of interest. For example, one assignment required the participants to find content, a video, an article, or a photograph, about global climate change and post it on the Facebook page. They were also asked to make two posts in response to a classmate's posts.

All of the participants interviewed stated they benefited from seeking content for the Course and sharing it through the Facebook page. As shown in the example below, Jim recognized the value of pursuing his own interests, making connections with his life outside the classroom, and understanding the environmental impact of his lifestyle at a deeper level:

It was not a typical homework assignment, more go out on your own time and find something that interests you. That allowed me to pick what I really wanted to put time into learning more about, the water cycle. I talked to my aunt in Los Angeles. She's a photographer and a lot of her pictures are of that smog hanging over the city. When you learn about it, you see it in your daily life. Facebook was huge. You could see it on so many different levels. (Jim)

Contributing further allowed students to follow other students' interests, to understand other students' positions, and to interact with the instructor. As Lori noted, "For me, it takes it out of the classroom setting. We can do our own research about the topic and post it. Maybe in that way we could teach the teacher too." Jane likewise noted,

Everyone brings something to the table. Everyone kind of had a chance to go out and find something related to the topic at first that they specifically were interested in. I think every class is going to be different just because of the people that are in it.

As the treatment group instructor noted, “Social media was a good overlay for instruction in the Course.” The treatment group instructor further corroborated the instructional value of having students contribute content to the Course:

Posting the media clips and photos with a summary was good because people could quickly look at them. More people brought information into the classroom from those clips and posts than they did with other assignments. It did not happen naturally, but as I started to answer more of the comments on student posts, there seemed to be more interaction between the students and me.

Posting strategies. Engagement in the learning environment could be seen in the participants’ desire to post quality content and exhibit competitiveness in their selection, as expressed by 43% of participants interviewed ($n = 3$). All participants in the study avoided posting the same thing as another participant had posted, and they looked for unique content. The participants who commented on this phenomenon in the interviews ($n = 3$) stated that if they saw that somebody had already posted an article, they felt compelled to find different content instead of posting the same content, and they made sure they had something that was useful to contribute:

It was kind of hard not posting the same thing as other people because most people resorted to Google. You had to at least skim through most of their stuff to make sure you did not get something so similar that it is basically the same thing. (Sandy).

I would generally look through what other people had posted and try and do something different . . . to find something interesting and relevant that was not already posted . . . because a few times, one of the articles I found had been posted. (Chrissy).

Keeping content current. Facebook use also provided an opportunity to bring current events and new media into the classroom or extended the learning environment in a manner that engaged participants and connected with their interests. Lori commented on the information, the

integrative nature of the technology, and the learning environment expanding outside the classroom:

It made it a lot more modern. These days, society is all about technology and how to use it. I thought it was really fun and interesting and it really took it out of the class. I thought it was also nice that [the instructor] would show us in class other people's [posts]—what other people posted.

The treatment group instructor also commented on the value of Facebook in keeping the content and discussion current:

I learned a lot. It helped the course to be more current so that people were finding events, gadgets, and technologies that were actually being used somewhere and throwing that into the class instead of the textbook, which gets updated every 2 years. I think it is different to see new stuff out there. That current-ness was there; they talked about things they had read or they'd posted or someone else had posted. They learned to search a little bit and look for things maybe that they would never have looked for before.

Moving instruction outside the classroom. The use of Facebook was not just an added component in the Course, but was used in Course instruction inside and outside the classroom. During classroom field observations, the researcher noted that students were encouraged to post information related to questions raised in class discussions on the Facebook page during class time. All interviewees from the treatment group thought the instructor integrated Facebook into classroom discussion in meaningful ways and that Facebook was used to enhance the learning environment:

I liked the way [the instructor], if she did not know something, she would either ask you or she would look it up while we were in class. If she did not find it, she would post it to Facebook after class. (Kerry)

Another example occurred during a classroom discussion on electric cars. The instructor proposed contacting a colleague who had an electric car so that students could ask questions the instructor was unable to answer at the time. When the instructor was unable to reach the colleague, she proposed that the class post questions to the external expert on Facebook so they

could all see the answers. Participants provided questions, and the instructor sent them to the electric car owner, who then posted answers on Facebook, to which students responded.

Even though all of the participants interviewed thought Facebook use helped create an engaging educational environment. The treatment group instructor voiced some disappointment about aspects of the intervention:

I envisioned success with the page to be that they would all be engaged at any given moment, they would be on Facebook, and there would be real-time interaction—you would see how they were using the course in their daily lives. At first, I was really disappointed that that was not happening and they were only posting what they had to post. But then I realized that it was a good tool to use because there was a way for them to interact that was easier than the discussion board.

Alternative Participation Pathways

The *alternative participation pathways* theme is defined as the ways in which Facebook facilitated the other three themes. Alternative participation pathways included removing barriers for shy students, providing more time to interact with classmates and the instructor, providing additional time to answer and discuss issues that arose during class discussions, and participating passively by reading the posts of classmates.

The use of Facebook created informal pathways for class participation inside and outside the classroom. More than 80% of all treatment group participants interviewed ($n = 6$) provided examples of how informal pathways for interaction benefited their engagement in the learning environment:

I had planned on deleting my Facebook before this class because I do not use it a whole lot. But it was neat how we used it. I thought it was going to be more [that the instructor] would post videos and we would watch them, but you would post your thoughts on something and then you could see your classmates and then [the instructor] would comment on something as well. It was an interesting way to do homework. (Jim)

In some cases, using Facebook provided pathways for participants to engage with groups, overcome shyness, and build confidence. Passive participation, such as “seeing what people

posted,” gave some students a sense of participation that was not obvious to the instructor or the researcher. Additionally, 43% of all treatment group participants interviewed ($n = 3$) indicated that they were not comfortable or did not like to speak out in class and Facebook helped them participate in the Course. As Sandy noted,

I am really bad at public speaking, even if I am sitting in a desk in a corner . . . but you have to post stuff on Facebook, where people are going to see it and they are going to know your perspective on things anyways, so there really is no point in not speaking. They have basically heard you talk just reading it.

Another participant, Jim, noted that Facebook helped overcome initial shyness and led to greater participation:

I like the class because I am a really shy person, in general. But once I get comfortable, you can't get me to stop talking. Being able to almost talk without being there, I was very comfortable being able to post a comment and hear other people's responses. It gives other people that are too shy to talk in person a chance to express themselves. (Jim)

Participants also noted that Facebook gave them an opportunity to engage in learning at a pace that allowed time for reflection, processing of information, and thoughtfulness. Using Facebook provided more time to think about a subject before speaking about it in class. As Jim said,

It gave me extra time to think about what we do on a daily basis. It was a different way to show your opinion. You could always find stuff to prove your point. It allowed for extra time, too. So if you're interested in something, I mean you could just put it on Facebook or someone else would. I mean in most, or all, my other classes, you cannot say, "I found this cool video. Can I show the class?"

These findings suggest that Facebook was an engaging overlay for Course instruction. Facebook use contributed to increasing engagement by making the learning environment more convenient to navigate and providing access to Course information through digital devices. Further, Facebook contributed to creating learner-centered activities that allowed participants to contribute content while exploring personal environmental stances. Facebook provided

alternative pathways for engagement in the learning environment through which participants could interact with the course material and their classmates. Using Facebook helped to create community among the treatment group participants and instructor by providing additional means to interact and have voice in the classroom. Thus it can be concluded that the level of engagement in the learning environment was enhanced and leveraged through the use of Facebook in the intervention, which in turn impacted student attitudes and public engagement activities.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

The present results indicate that the use of Facebook supported learning, had a positive impact on student attitudes, facilitated public engagement actions and intentions to act, and supported an engaging learning environment. Findings show statistically significant differences in attitude about global climate change in favor of the intervention group. Using Facebook throughout the semester contributed to the maintenance of and shifts toward greater concern about global climate change for this group. In fact, this study showed that participants who did not use Facebook became more disengaged in their attitudes about global climate change. The treatment group demonstrated more engagement in environmental issues and reported more than double the numbers of public engagement actions and intentions to act than the comparison group. Participant engagement with Facebook enhanced the learning environment. Facebook provided convenient methods of communication and handling of course logistics. Facebook further enhanced the learning environment by creating participation pathways for students in addition to the more traditional methods used in the comparison course. Facebook use aided in sustained engagement with environmental issues providing more time and opportunity for students to discuss and contribute relevant content. Content knowledge gains measured were the result of instruction with little apparent impact by the Facebook component of the intervention.

Impact of Facebook on Course Learning Environment

Impact on Attitudes

The attitude differences measured between the treatment group and comparison group may be attributed to students' enhanced engagement with the Course material and, in particular,

the issue of global climate change. The main difference between the two groups was the use of Facebook, which begs the question, “What about Facebook can account for the change in attitude?” Facebook provided students the opportunity to present multiple and varying views, hear or *see* the stances of their classmates, and provide a non-confrontational medium to express conflicting views. Self-guided contributions to the Course with real-time feedback from classmates and the instructor allowed students to pursue subjects that interested them. Additionally, Facebook provided a casual and convenient platform to consider the environmental issues they were studying in a way that was familiar to them. Even though this form of interaction with the subject material was primarily superficial and did not result in deep discussion as evident in the overall lack of multi-threaded Facebook discussions, the face value of interacting with the Course subject matter and their peers seems to have kept students interested and engaged with the Course content and ideas throughout the semester.

Research shows that one potentially negative impact on attitudes toward global climate change could be related to being overwhelmed by the complexity and unsolvable nature of such an issue (Hudson, 2001). In this study, Facebook use appears to have mitigated some of the fatigue associated with facing hard issues and provided a platform for staying hopeful and engaged:

Facebook definitely promoted some conversations. I added a couple of friends from the class because of it. I was able to get a good connection, keep it going down the road, not just this semester – if I post something related to the environment that they would post or comment on. (Matt)

Facebook use was also an area where instruction and the active learning environment encouraged individual responsibility and purpose through personal actions, which are key to avoiding the psychology of despair associated with environmental issues (Hudson, 2001; Ramaley & Leskes, 2002).

Impact on Engagement Actions and Stated Intention to Act

Facebook use appeared to have boosted engagement possibilities as was seen by the number of engagement actions noted and the stated intentions to act. However, somewhere between knowledge and action lies the intent to act. Using Facebook in the active learning environment supported increased engagement in class and outside the classroom, serving to model social engagement. Treatment group participants considered communication through Facebook to be an act of engagement. Examples of this can be seen in the way Facebook was used as a medium for social action (both positive and negative) in the August 2011 riots in London. The engagement actions reported tended to be small, personal actions that impacted participants' lives directly or the lives of their friends and family, such as sharing information through Facebook or turning down the thermostat in their homes. Participants recognized that even the smallest actions were possibly impactful, which helped build hope that might cause further positive engagement with the issue of global warming (MTV, 2007; Hudson, 2001).

One possible explanation for the sense of engagement observed through self-reported actions and intentions to act is that the use of Facebook spoke to the young adult participants because of characteristics in line with those ascribed to digital natives, such as preferences for connectivity and use of technology (Oblinger & Oblinger, 2005; Prensky, 2001). The self-reported actions and intentions to act may be indicative of different perceptions of participation or engagement by members of this age group, which vary considerably from those of previous generations or digital immigrants. For example, a similar study with digital immigrants might result in different levels of action or intentions to act (Prensky, 2001).

What remains unclear from the present study is the degree to which students will follow through with stated intentions to act. Are they stating intentions because they are more engaged

than previously, because they think they should state intentions to act, or for some other purpose? What is the role of SM, if any, in bridging this process from intention to act to actually undertaking an action?

Facebook in the Active Learning Environment

A stated instructional goal for the Course was to provide a learning environment in which students could become self-guided learners, and interested, engaged citizens who use the analytical skills developed in class to become lifelong learners. Facebook provided new and possibly much more familiar pathways for students to explore this potential. One way in which this happened was using Facebook to create a student-centered learning environment.

Assignments in which students contributed content, such as posting videos and articles about a given subject, allowed for modes of interaction previously not available through more traditional means. An interesting phenomenon that resulted during these activities was a self-censoring tendency to make certain that content located and posted by participants in the intervention group was a unique contribution to the Course, an assignment, and/or a discussion. Students, without being asked or instructed, never posted duplicate content.

Facebook helped to achieve educational objectives by providing real-time student-to-student and student-to-instructor interaction, expanding the discussion of environmental issues beyond the classroom, and by enabling students to contribute content through an easily accessible platform. Treatment group interviewees noted a sense of one-on-one instruction and an expanded sense of interaction between the classroom and their classmates. Students clearly realized the value of easy access and convenience of using Facebook in the Course. The convenience factor was one of the main benefits of the Facebook component. The ability to communicate in small and simple ways may, in fact, be part of the appeal of using Facebook in

the instructional setting. For example, inviting participants to contribute to Course content and answer questions during class discussions through Facebook influenced the classroom boundaries by adding an external component to the learning environment.

The connection among Facebook, learning outcomes, and the social dimensions of individual learning provided supporting evidence that these digital natives enjoy community and connectivity in education (Oblinger & Oblinger, 2005; Prensky, 2001; Yu et al., 2010). This came through clearly from participants who expressed dissatisfaction that more community was not created through the Facebook page. Yet, others felt connected to community because, although students were not talking about deep issues, they could passively *see* what classmates were thinking. This passive viewing of Facebook appeared to be less threatening than the formal classroom discussions for some participants and helped them engage, albeit passively, by overcoming the shyness they noted during individual interviews. By creating passive interactions, these students had more time to engage with content on the Facebook page and a greater sense of others' views, which may have allowed them to be more comfortable expressing their ideas in print, before speaking in class, thereby facilitating group interaction.

Implications for Instruction

Neither constructivist theories about active learning nor the use of media and technology in learning environments are new (Rheingold, 2008). This study demonstrates that if use of SM is to have an impact, it has to be part of planned instructional activities and goals. Social media can enhance learning environments if used intentionally and with sufficient exposure. A differential in Facebook use was clearly seen between the intervention group and the comparison group. The treatment group used Facebook to discuss environmental issues, post content, communicate with the instructor, and share information. In contrast, albeit made available to

them, the comparison group participants were not engaged in using Facebook during the study as was indicated by the complete lack of use of the optional Facebook page.

Accountability for Facebook use in the learning environment is needed if the full benefits are to be realized. Merely creating an opportunity to use Facebook is not enough to encourage students to actively use it for educational purposes. Purposeful activities such as assignments, in-class discussions, content contribution, and grade accountability are needed to provide meaningful engagement with SM as an instructional aide, as could be seen from the differential engagement of the two student groups.

Prolonged exposure to SM is also needed to ensure integration into the classroom. This study showed that the implementation of Facebook into the educational learning environment took time for students to adjust and adapt. After a rather slow start, treatment group participants became much more comfortable with the use of Facebook in the educational setting over the course of the semester, which was seen in the increased numbers as posts starting with the fourth week in the courses and throughout the remainder of the semester. Additionally, using Facebook inside and outside of the classroom became second nature to the treatment group participants over the course of the study as evident by researcher classroom observations, Facebook posts, and interview comments. This increased level of comfort over time was due in part to becoming familiar with how Facebook was being used in the class and what was expected to complete Course assignments.

Integration of Facebook into planned instruction was an effective overlay in the educational environment because it met students where they already were socially engaged. Effective SM use in learning environments should provide purposeful, intentional, and meaningful use of the platform, involving students as active participants in the learning process.

Making a Facebook page available without any planned interaction was not enough to trigger participation as evidenced by the lack of comparison group activity on Facebook. For the treatment group, it was essential to have meaningful ways to use SM that integrated with content and activities in the active learning environment. Classroom discussions and assignments were both particularly effective for engaging students in this study. However, Facebook did not replace traditional communication, course management tools, or content delivery, but rather created additional methods for engaging students in self-directed learning, classroom dialog, and public engagement.

Based on the themes that were evident with students, *convenience and logistics*, *community and communication*, *engaging learning environment*, and *alternative participation pathway*, the active learning environment can be bolstered by using SM. Instructors would do well to consider utilizing Facebook and other SM to convey logistical information for homework assignments and meeting places. Other instructional uses could involve mediated attempts to create community among learners and expand that community to other classrooms around the world, for example to discuss environmental issues from differing perspectives. Examining the potential of the alternative pathways of participation noted could include having students create media campaigns or use SM in service learning projects. Additionally, Facebook has potential as a formative assessment tool for instructors to gain insights into student attitudes and activities in the learning environment. The potential for enrichment of the learning environment by using Facebook or other SM outweighs the initial time demands to establish meaningful methods of using the media.

Future Research

This study was among the few, including Yu et al. (2010) and Williams and Chin (2009), to provide an empirical assessment of the impacts of SM, in this case Facebook, as an instructional aide on outcomes related to attitudes and engagement with environmental actions in a *formal* learning setting. Use of Facebook contributed to attitude change and engagement actions and intentions to act. Additional research is needed to determine if there is a correlation between stated intentions to act and actual public engagement actions undertaken, and the role SM plays in the process. Another area in which additional work would be beneficial is in understanding whether SM can be used to bridge the activation gap between intention and action, as described by Rheingold (2008), giving young adults an increased sense of involvement in long-term issues such as global climate change beyond the classroom. Lastly, an examination of the interplay and connections between SM, public and civic engagement, and environmental issues is needed to further the refinement of theories using SM.

In this study, Facebook proved to be a promising pathway for teaching public engagement strategies in this educational setting because Facebook facilitated social interaction while acting as a mode of self-expression. It has been shown that when used deliberately, Facebook can effectively contribute to an active learning environment.

REFERENCES

- Adger, W. N. (2003). Social capital, collective action, and adaptation to climate change. *Economic Geography*, 79(4), 387–404.
- Anderson, P. (2007). *What is Web 2.0? Ideas, technologies and implications for education*. Briston: Joint Information Systems Committee.
- Bardaglio, P. W., & Putman, A. (2009). *Boldly sustainable: Hope and opportunity for higher education in the age of climate change*. Washington, DC: National Association of College and University Business Officers.
- Barnes, K., Marateo, R. C., & Ferris, S. (2007). Teaching and learning with the Net generation. *Innovate*, 3(4). Retrieved from <http://innovateonline.info>
- Bennett, W. L. (2008). Changing citizenship in the digital age. In W. L. Bennet (Ed.), *Civic life online: Learning how digital media can engage youth* (pp. 1–24). Cambridge, MA: MIT Press.
- Blankenship, M. (2011). How social media can and should impact higher education. *Education Digest*, 76(7), 39–42.
- Borette, D. S., & Seltzer, T. (2009). Dialogic strategies and outcomes: An analysis of environmental advocacy groups' Facebook profiles. *Public Relations Review*, 35, 317–319.
- Boyd, D. M., & Ellison, N. B. (2007). Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication*, 13(1), article 11. Retrieved from <http://jcmc.indiana.edu>
- Boykoff, M. T., & Boykoff, J. M. (2004). Balance as bias: Global warming and the US prestige press. *Global Environmental Change*, 14, 125–136.
- Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academies Press.
- Brown, J. S. (2002). Growing up digital. *Change*, 32(2), 10–20.
- Brown, M. (2005). Learning spaces. In D. Oblinger & J. Oblinger (Eds.), *Educating the Net generation*. Boulder, CO: EDUCAUSE. Retrieved from <http://www.educause.edu/library/resources/educating-net-generation-0>
- Chapman, E. (2003). Alternative approaches to assessing student engagement rates. *Practical Assessment, Research & Evaluation*, 8(13). Retrieved from <http://PAREonline.net/getvn.asp?v=8&n=13>

- Chen, W., Boase, J., & Wellman, B. (2002). The global villagers: Comparing Internet users and uses around the world. In B. Wellman & C. Haythornthwaite (Eds.), *The Internet in everyday life* (pp. 74–113). Oxford, United Kingdom: Blackwell.
- Clayton-Pedersen, A., & O’Neill, N. (2005). Curricula designed to meet 21st-century expectations. In D. Oblinger & J. Oblinger (Eds.), *Educating the Net generation*. Boulder, CO: EDUCAUSE. Retrieved from <http://www.educause.edu/library/resources/educating-net-generation-0>
- Corder, G. D., & Foreman, D. I. (2009). *Nonparametric statistics for non-statisticians*. Hoboken, NJ: Wiley.
- Cortese, A. D. (2003). The critical role of higher education in creating a sustainable future. *Planning for Higher Education*, 31(3), 15–22.
- Course Instructor. (2007). *Entrepreneurial environmental awareness: A proposal for the Academy of Entrepreneurial Leadership*. Course Proposal.
- Dahlstrom, E., De Boor, T., Grunwald, P., & Vockley, M. (2011). *The ECAR study of undergraduates and information technology, 2011*. Boulder, CO: EDUCAUSE. Retrieved from <http://www.educause.edu/ecar>
- Dietz, T., Ostrom, E., & Stern, P. C. (2003, December 12). The struggle to govern the commons. *Science*, 302, 1907–1912.
- DiMaggio, P., Hargittai, E., Neuman, W. R., & Robinson, J. P. (2001). Social implications of the Internet. *Annual Review of Sociology*, 27, 307–336.
- Donath, J., & Boyd, D. (2004). Public displays of connection. *BT Technology Journal*, 22(4), 71–81.
- Ellison, N. B., Steinfield, C., & Lampe, C. (2007). The benefits of Facebook “friends:” Social capital and college students’ use of online social network sites. *Journal of Computer-Mediated Communications*, 12, 1143–1169.
- Elwood, S. (2008). Volunteered geographic information: Future research directions motivated by critical, participatory, and feminist GIS. *GeoJournal*, 72, 173–183.
- Facebook. (2011). *Facebook Page Insights: Product guide for Facebook Page owners*. Retrieved from <http://ads.ak.facebook.com/ads/creative/insights/page-insights-guide.pdf>
- Garton, L., Haythornthwaite, C., & Wellman, B. (1997). Studying online social networks. *Journal of Computer-Mediated Communication*, 3(1), 0-0.
- Graffam, B. (2007). Active learning in medical education: Strategies for beginning implementation. *Medical Teacher*, 29(1), 38–42.

- Green, M. C. (2007). Trust and social interaction on the Internet. In A. Joinson, K. McKenna, T. Postmes, & U. Reips (Eds.), *Oxford handbook of Internet psychology* (pp. 43–51). Oxford, United Kingdom: Oxford University.
- Hargittai, E. (2003). The digital divide and what to do about it. In D. Jones (Ed.), *New economy handbook* (pp. 822–841). San Diego, CA: Academic Press.
- Haythornthwaite, C. (2007a). Digital divide and e-learning. In R. Andrews & C. Haythornthwaite (Eds.), *Handbook of E-learning research* (pp. 97–118). London, United Kingdom: Sage.
- Haythornthwaite, C. (2007b). Social networks and online community. In A. Joinson, K. McKenna, T. Postmes & U. Reips (Eds.), *Oxford handbook of Internet psychology* (pp. 121–136). Oxford, United Kingdom: Oxford University.
- Haythornthwaite, C., & Hagar, C. (2005). The social worlds of the web. *Annual Review of Information Science and Technology*, 39, 311–346.
- Herbertson, K., Ballesteros, A. R., Goodland, R., & Munilla, I. (2009). Breaking ground: Engaging communities in extractive and infrastructure projects. Washington, DC: World Resources Institute.
- Hewitt, A., & Forte, A. (2006, November). *Crossing boundaries: Indentity management and student/faculty relationships on the Facebook*. Poster session presented at the Computer Supported Cooperative Work and Social Computing 2006, Banff, Alberta, Canada.
- Hill, R. (2012). Civic engagement and environmental literacy. *New Directions for Adult & Continuing Education*. 135, 41-50.
- Howe, N., & Strauss, B. (2000). *Millennials rising: The next generation*. New York, NY: Vintage Books.
- Huberman, B. A., Romero, D. M., & Wu, F. (2009). Social networks that matter: Twitter under the microscope. *First Monday*, 14(1). Retrieved from <http://ojphi.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/viewArticle/2317>
- Hudson, S. J. (2001). Challenges for environmental education: Issues and ideas for the 21st Century. *BioScience*. 51(4), 283-288.
- Hund, G., & Judd, K. (2008, November). *Stakeholder acceptance issues concerning advanced coal power plants with carbon capture and storage: Lessons learned from FutureGen*. Paper presented at the 9th International Conference on Greenhouse Gas Control Technologies, Washington, DC.
- International Energy Agency (IEA). (2009). *Technical roadmap: Carbon capture and storage*. Paris, France: Author.

- Intergovernmental Panel on Climate Change (IPCC). (2007). *Climate change 2007: Synthesis report. Contribution of Working Groups I, II, and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva, Switzerland: Author.
- Ito, M., Horst, H. Bittanti, M., Boyd, D., Herr-Stephenson, B., Lange, P. G., Pascoe, C. J., & Robinson, J. (Eds.). (2009). *Living and learning with new media: Summary of findings from the Digital Youth Project*. Cambridge, MA: MIT Press.
- Jenkins, H., Clinton, K., Purushotma, R., Robinson, A. J., & Weigel, M. (2006). *Confronting the challenges of participatory culture: Media education for the 21st Century*. Chicago, IL: MacArthur Foundation.
- Joinson, A. N., McKenna, K., Postmes, T., & Reips, U. (2007). *The Oxford handbook of Internet psychology*. New York, NY: Oxford University Press.
- Jones, P., Selby, D., & Sterling, S. (Eds.). (2010). *Sustainability education*. London, United Kingdom: Earthscan.
- Kame, L. (2004). Education, learners and active learning methodologies. *International Journal of Lifelong Education*, 23(3), 275–286.
- Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of social media. *Business Horizons*, 53, 59–68.
- Katz, J. E., & Rice, R. E. (2002). *Social consequences of Internet use: Access, involvement, and interaction*. Cambridge, MA: MIT Press.
- Kelleher, T. (2007). *Public relations online*. Thousand Oaks, CA: Sage.
- Kitcher, P. (2010, June 4). The climate change debates. *Science*, 328, 1230–1234.
- Land, S. M., & Hannafin, M. J. (2000). Student-centered learning environments. In D. H. Jonassen & S. M. Land (Eds.), *Theoretical foundations of learning environments* (pp. 1–23). Mahwah, NJ: Lawrence Erlbaum.
- Leiserowitz, A., Maibach, E., & Roser-Renouf, C. (2008). *Global Warming's "Six Americas": An audience segmentation*. New Haven, CT: Yale Project on Climate Change, Yale University and George Mason University. <http://environment.yale.edu>
- Leiserowitz, A., Maibach, E., Roser-Renouf, C., & Smith, N. (2010). *Global Warming's Six Americas, June 2010*. New Haven, CT: Yale Project on Climate Change, Yale University and George Mason University. Retrieved from <http://environment.yale.edu/climate/files/SixAmericasJune2010.pdf>

- Leiserowitz, A., Maibach, E., Roser-Renouf, C., & Smith, N. (2011). *Global Warming's Six Americas, May 2011*. New Haven, CT: Yale Project on Climate Change, Yale University and George Mason University. Retrieved from <http://environment.yale.edu/climate/files/SixAmericasMay2011.pdf>
- Leiserowitz, A., Smith, N., & Marlon, J. R. (2010). *Knowledge of climate change across Global Warming's Six Americas*. Yale University. New Haven, CT: Yale Project on Climate Change, Yale University and George Mason University.
- Lenhart, A., Horrigan, J., Rainie, L., Allen, K., Boyce, A., Madden, M., & O'Grady, E. (2003). *The ever-shifting Internet population: A new look at Internet access and the digital divide*. Retrieved from <http://www.pewinternet.org/Reports/2003/The-EverShifting-Internet-Population-A-new-look-at-Internet-access-and-the-digital-divide.aspx?r=1>
- Lenhart, A., Purcell, K., Smith, A., & Zickuhr, K. (2010). *Social media & mobile Internet use among teens and young adults*. Washington, DC: Pew Research Center. Retrieved from <http://pewinternet.org/reports/2010/Social-Media-and-Young-Adults.aspx>
- Livingstone, S., Couldry, N., & Markham, T. (2007). Youthful steps toward civic participation: does the Internet help? In B. D. Loader (Ed.), *Young citizens in the digital age: Political engagement, young people and new media* (pp. 21–34). London: Routledge.
- Louder, B. D. (Ed.). (2007). *Young citizens in the digital age: Political engagement, young people and new media*. London, United Kingdom: Routledge.
- Madden, M. (2010). *Older adults and social media: Social networking use among those ages 50 and older nearly doubled over the past year*. Washington, DC: Pew Research Center. Retrieved from <http://pewinternet.org/Reports/2010/Older-Adults-and-Social-Media.aspx>
- Madge, C., Meek, J., Wellens, J., & Hooley, T. (2009). Facebook, social integration and informal learning at university: 'It is more for socialising and talking to friends about work than for actually doing work.' *Learning, Media, and Technology*, 34(2), 141–155.
- Maibach, E. W., Leiserowitz, A., Roser-Renouf, C., & Mertz, C. K. (2011a). Identifying like-minded audiences for global warming public engagement campaigns: An audience segmentation analysis and tool development. *PLoS ONE* 6(3), e17571.
- Maibach, E. W., Leiserowitz, A., Roser-Renouf, C., Mertz, C. K., & Akerlof, K. (2011b). *Global Warming's Six Americas screening tools: Survey instruments; instructions for coding and data treatment; and statistical program scripts*. New Haven, CT: Yale Project on Climate Change, Yale University and George Mason University. Retrieved from <http://climatechangecommunication.org/SixAmericasManual.cfm>
- Malka, A., Krosnick, J. A., & Langer, G. (2009). The association of knowledge with concern about global warming: Trusted information sources shape public thinking. *Risk Analysis*, 29(5), 633–647.

- Mazer, J. P. Murphy, R. E., & Simonds, C. J. (2007). I'll see you on "Facebook": The effects of computer-mediated teacher self-disclosure on student motivation, affective learning, and classroom climate. *Communication Education, 56*(1), 1–17.
- McBride, T., & Nief, R. (2011). *The mindset lists of American history*. Hoboken, NJ: Wiley.
- McCallie, E., Bell, L., Lohwater, T., Falk, J. H., Leher, J. L., Lewenstein, B. V., Needham, C., & Wiehe, B. (2009). *Many experts, many audiences: Public engagement with science and informal science education*. Washington, DC: CAISE Inquiry Group. Retrieved from http://caise.insci.org/uploads/docs/public_engagement_with_science.pdf
- McCright, A. M., & Dunlap, R. E. (2011). The politicization of climate change and polarization in the American public's view of global warming, 2001-2010. *The Sociological Quarterly, 52*(2), 155-194.
- McNeely, B. (2005). Learning spaces. In D. Oblinger & J. Oblinger (Eds.), *Educating the Net generation*. Boulder, CO: EDUCAUSE. Retrieved from <http://www.educause.edu/library/resources/educating-net-generation-0>
- MTV. (2007). *Just cause: Today's activism*. Retrieved from <http://www.mtv.com/thinkmtv/research/pdf/Just.Cause.FNL.APX.pdf>
- Newig, J., Haberl, H., Pahl-Wostl, C., & Rothman, D. S. (2008). Formalised and non-formalised methods in resource management-knowledge and social learning in participatory process: An introduction. *Systemic Practice and Action Research, 21*, 381–387.
- Nisbet, M. C. (2009, March–April). Communicating climate change: Why frames matter for public engagement. *Environment*. Retrieved from <http://www.environmentmagazine.org>
- Oblinger, D. (2003, July/August). Boomers, Gen-Xers, & Millennials: Understanding the new students. *EDUCAUSE, 37*–47.
- Oblinger, D., & Oblinger, J. (2005). Is it age or IT: First steps toward understanding the Net Generation. In D. Oblinger & J. Oblinger (Eds.), *Educating the Net generation*. Boulder, CO: EDUCAUSE. Retrieved from <http://www.educause.edu/library/resources/educating-net-generation-0>
- O'Reilly, T. (2005). *What is Web 2.0*. Retrieved from <http://oreilly.com/web2/archive/what-is-web-20.html>
- Park, N., Kee, K. F., & Valenzuela, S. (2009). Being immersed in social networking environment: Facebook groups, uses and gratifications, and social outcomes. *CyberPsychology & Behavior, 12*(6), 729–733.

- Pempek, T. A., Yermolayeva, Y. A., & Calvert, S. L. (2009). College students' social networking experiences on Facebook. *Journal of Applied Developmental Psychology, 30*, 227–238.
- Pfeil, U., Arjan, R., & Zaphiris, P. (2009). Age differences in online social networking: A study of user profiles and the social capital divide among teenagers and older users in MySpace. *Computers in Human Behavior, 25*(3), 643–654.
- Prensky, M. (2001, September/October). Digital natives, digital immigrants part 1. *On the Horizon, 9*(5), 1–6.
- Quan-Haase, A., Wellman, B., Witte, J. C., & Hampton, K. N. (2002). Capitalizing on the Net: Social contact, civic engagement and sense of community. In B. Wellman & C. Haythornthwaite (Eds.), *The Internet in everyday life* (pp. 291–324). Oxford, United Kingdom: Blackwell.
- Rafaeli, S., & Ariel, Y. (2007). Assessing interactivity in computer-mediated. *Oxford Handbook of Internet Psychology, 71*.
- Rainie, L., Madden, M., Boyce, A., Lenhart, A., Horrigan, J., & Allen, K. (2003). *The ever-shifting Internet population: A new look at Internet access and the digital divide*. Washington, DC: Pew Internet & American Life Project.
- Ramaley, J. A., & Leakes, A. (2002). *Greater expectations: A new vision for learning as a nation goes to college*. Washington, DC: Association of American Colleges and Universities.
- Rheingold, H. (2008). Using participatory media and public voice to encourage civic engagement. In W. L. Bennet (Ed.), *Civic life online: Learning how digital media can engage youth* (pp. 97–118). Cambridge, MA: MIT Press.
- Roberts, G. R. (2005). Technology and learning expectations of the Net generation. In D. Oblinger & J. Oblinger (Eds.), *Educating the Net generation*. Boulder, CO: EDUCAUSE. Retrieved from <http://www.educause.edu/library/resources/educating-net-generation-0>
- Roblyer, M. D., McDaniel, M., Webb, M., Herman, J., & Witty, J. V. (2010). Findings on Facebook in higher education: A comparison of college faculty and student uses and perceptions of social networking sites. *Internet and Higher Education, 13*, 134–140.
- Rowe, G., & Frewer, L. J. (2005). A typology of public engagement mechanisms. *Science, Technology, & Human Values, 30*(2), 251–290.
- Rowe, G., Marsh, R., & Frewer, L. J. (2004). Evaluation of a deliberative conference. *Science, Technology, & Human Values, 29*(1), 88–121.

- Selwyn, N. (2008). An investigation of differences in undergraduates' academic use of the Internet. *Active Learning in Higher Education*, 9(1), 11–22.
- Selwyn, N. (2009). Faceworking: Exploring students' education-related use of Facebook. *Learning, Media and Technology*, 34(2), 157–174.
- Sterling, S. (2001). *Sustainable education: Re-visioning learning and change*. Bristol, United Kingdom: J.W. Arrowsmith.
- Taylor, M., Kent, M. L., & White, W. J. (2001). How activist organizations are using the Internet to build relationships. *Public Relations Review*, 27(3), 263–284.
- Thomas, H. (2010). Learning spaces, learning environments and the dis'placement' of learning. *British Journal of Educational Technology*, 41(3), 502–511.
- Tredinnick, L. (2006). Web 2.0 and business: A pointer to the intranets of the future? *Business Information Review*, 23, 228–234.
- Valenzuela, S., Park, N., & Kee, K. F. (2009). Is there social capital in a social network site?: Facebook use and college students' life satisfaction, trust, and participation. *Journal of Computer-Mediated Communication*. 14(4), 875-901.
- Vogt, W. P. (2005). *Dictionary of statistics and methodology* (3rd ed.). Thousands Oaks, CA: Sage.
- Waters, R. D. (2007). Nonprofit organizations use of the Internet: A content analysis of communication trends on the Internet sites of the organizations on the Philanthropy 400. *Nonprofit Management & Leadership*, 18(1), 59–76.
- Williams, J., & Chinn, S. J. (2009). Using Web 2.0 to support the active learning experience. *Journal of Information Systems Education*, 20, 165–172.
- Woolcock, M., & Narayan, D. (2000). Social capital: Implications for development theory, research, and policy. *World Bank Research Observer*, 15, 225–249.
- Youniss, J., McLellan, J. A., & Yates, M. (1997). What we know about engendering civic identity. *The American Behavioral Scientist*, 40(5), 620–631.
- Yu, A. Y., Tian, S. W., Vogel, D., & Kwok, R. C. (2010). Can learning be virtually boosted? An investigation of online social networking impacts. *Computers & Education*, 55, 1494–1503.
- Zickuhr, K. (2010). *Generations 2010*. Washington, DC: Pew Internet & American Life Project.

APPENDIX A

COURSE SYLLABUS

DATES	MODULE, TOPIC & FOOTPRINT *Preflight	LABORATORY Off-Campus Field Trips are in BOLD	QUIZ DUE
	Content Prequiz		28 Aug
22 Aug- 02 Sept (2 weeks)	1 The Planet <i>Ecological Footprint</i>	Science <i>Wear safety glasses/goggles</i>	02 Sept
		Prairie Ecosystem <i>Wear clothing for outdoors</i>	
06 Sept- 16 Sept (2 weeks)	2* Energy <i>Electricity Audit</i>	Energy Audit	16 Sept
19 Sept- 23 Sept (1 week)	3* Demography <i>Pop. Simulation</i>	Populations and Natural Selection	23 Sept
26 Sept- 07 Oct (2 weeks)	4* Stuff: Consumption & Waste <i>Stuff Footprint</i>	Alternative Shopping	07 Oct
		Recycling Facility <i>Wear clothing for outdoors</i>	
10 Oct- 14 Oct (1 week)	5* Making Choices	No lab	14 Oct
17 Oct- 21 Oct (1 week)	5* Making Choices <i>Skin Deep</i>	Copper Remediation <i>No skin exposed; wear safety goggles and gloves</i>	21 Oct
24 Oct- 04 Nov (2 weeks)	6* Air <i>Air Quality Analysis, Carbon Footprint</i>	Car Exhaust <i>No skin exposed; wear safety goggles and gloves</i>	04 Nov
		Forest Restoration <i>Wear clothing for outdoors; bring work gloves</i>	
07 Nov- 18 Nov (2 weeks)	7* Water <i>Water Footprint</i>	Water Quality	18 Nov
		Wastewater Treatment Tour <i>Wear clothing for outdoors</i>	
21 Nov- 02 Dec (2 weeks)	8* Food Security <i>Alternative Holiday</i>	Organic Farm Tour	02 Dec
		Pollinatarium Tour	
05 Dec- 09 Dec (1 week)	9* Cities/Finale	Solar House Tour <i>Wear clothing for outdoors</i>	09 Dec
12 Dec- 16 Dec	Content Postquiz Finals		

APPENDIX B

SOCIAL MEDIA FOOTPRINT ASSIGNMENT

What is a footprint?

The first step to living a greener life is to know how you live. It is impossible to use less, recycle more, unless you know how much you use and recycle! To determine this, you can calculate what we call your “ecological footprint.” Your footprint is the impact your lifestyle has on the natural capital of the earth. Ideally, you will calculate this by recording every tiny thing you purchase, use, and throw away, every drop of water you use and let go down the drain, how much you drive in what kind of car . . . To truly know your footprint, you must know many details about your lifestyle.

Since most of us don’t really want to do that, you can quickly calculate your footprint by using online calculators that at least give you the gist of what impact you have where. Once you know your impact, you will know where you can focus your resources to live greener, and where you are already green! All of these sites also have information about the issues, and tips for reducing your footprint too.

Ecological Footprint

This quiz asks you numerous questions about your lifestyle, from how large your house is to how much meat you eat each week. The final calculation is how many earths we would need if all the people on the planet were to live your lifestyle.

1. Go to the Course Facebook page.
2. On the bottom left is a series of pages and individuals that we as a course have liked. You’ll see a site called:



3. Ecological Footprint Quiz, myfootprint.org.
4. Click on that, and it will take you to the myfootprint.org Facebook page.
5. To access the actual quiz (which is a website), click on the www.myfootprint.org link on the

left under the “About” heading.

6. Alternatively, you can go directly to the <http://myfootprint.org> website.

Take the ecological footprint quiz. You do not need to sign up with your e-mail account. Be thoughtful about the answers, and take your time to answer to the best of your ability. At the end of the quiz, you will see several graphs. By the due date on the calendar, post the following on the Course Facebook page:

- The number of earths you need.
- The consumption categories in order from highest to lowest.
- Two ways YOU could realistically reduce your footprint and why those would work for you. You can use the red “Reduce your footprint” boxes on the final results page, think of your own ideas, or Google them. Feel free to also post links to sites that would give others ideas for reducing their footprints.
- Two flaws in this quiz. What are some ways that make the results untrustworthy?
- Feel free to post relevant links and information on the course Facebook page, but be sensitive to cluttering it up.
- Before the class period listed on the Course calendar, read through your classmates’ postings and be prepared to discuss them in class.

APPENDIX C
FINAL EXAMINATION

Exam Instructions

The following rules apply to these exams:

1. Sign up with your instructor for a 30-minute time slot. This is an exam, so please be on time and act responsibly if you cannot make the exam on time. You must give 24-hour notice regarding exam time changes. If you are more than 10 minutes late to your time slot, you will earn a zero. Make-ups are the prerogative of the instructor and are not guaranteed.
2. You will be graded on thoroughness, preparedness, accuracy, and your ability to think past the question.
3. Be prepared to answer all of the questions for each exam. During your exam time, you will randomly choose three of the questions, and you will answer these three.
4. You will have ~7 minutes to give your answer, so please be prepared and keep your answer concise and on topic. You are restricted to the time limit that the instructor gives you, so be prepared to answer your questions within that time!
5. You may have notes for each question. Notes are meant to be a crutch, not something from which you can read your answer. Do **not** read your answers. Your note cards are **only** to be used as references to help you remember words or remind you of drawings. You will be required to turn your notes for all questions in at the end of your exam.
6. You may use the textbooks, Internet, and work with people, but you must have **your own examples and statements!**
7. Do **not** copy (or memorize) from the textbook or any of your resources. That is considered **plagiarism** and you will earn a zero for the question.
8. **None** of these answers are in your textbooks! Use your books as a guide and as a resource for facts. Answer these questions by thinking about the answers, using resources to help you be creative and accurate with your thoughts. Most of the questions have an answer formed by your own opinion and understandings, and the only “right” answer is one of scientific integrity. Occasionally, as when discussing the action of a pollutant, there may be a “right” answer, but you will need to come to it yourself as the answer is not always in your book.
9. Remember that your grade on these exams is entirely within your control, so put some effort into answering the questions.

Oral Exam Questions

25 points each

1. Find a news article that describes a human impact on a biome and the natural capital of that biome. You need to:
 - a. Describe what the biome is that you chose.
 - b. Describe the human activity, what it is and why we do it.
 - c. Describe how that activity impacts the biome and natural capital of that biome. The impact can be a boon or a threat to the biome.
 - d. Describe the impacts to human society of the changes in the biome that you describe in part c.
 - e. Be able to talk about the sources you used.

2. Choose a country in the world. State the following:
 - a. Population size
 - b. Population density
 - c. Population growth
 - d. Fertility rate
 - e. Male: Female ratio
 - f. Draw an age structure diagram (at least a generic one)
 - g. What are the future demographic projections for this country? Find at least population size and growth.
 - h. What are the reasons for this future growth?
 - i. What are the implications of this future growth?
 - j. Describe any major demographic concerns going on in this country.
 - k. Be able to talk about the sources you used.

3. Find one real, specific case of environmental injustice somewhere in the world. This case must involve climate change in some manner.
 - a. Describe the situation.
 - b. Describe who the major players are (the culprits and the victims).
 - c. Describe what the environmental problem is.
 - d. Draw a sustainability triangle for the situation, and be able to describe what you drew.
 - e. Using Rawl's two principles of justice (listed below in italics; i.e., blind, rational, amnesiac), what should happen to make the situation more just? (Don't focus on economics, politics, etc.; simply focus on justice.)
 - *Each person has an equal claim to a fully adequate scheme of basic rights and liberties, which scheme is compatible with the same scheme for all; and in this scheme the equal political liberties, and only those liberties, are to be guaranteed their fair value.*
 - *Social and economic inequalities are to satisfy two conditions: first they are to be attached to positions and offices open to all under conditions of fair equality of opportunity; and second they are to be to the greatest benefit of the least advantaged members of society.*

4. Make a personal action plan toward a more sustainable daily life. Begin by considering your footprints from class and assessing where you could make changes and reduce your impact.

Once you make your plan, DO IT for at least three consecutive days (at least one a business day). Keep a journal of your daily activities and where you decided to reduce. The journal must consist of the following parts:

- a. A statement of what your personal action plan is and why you decided to do the things you have chosen to do.
- b. A statement telling your instructor where to find your journal.
- c. A journal entry explaining the things you tried to do/did/failed to do each day of your trial.
- d. A summary and a reflection on your experience. What was easy, challenging, rewarding? Can you continue to do these things, etc.?

NOTE: You may use whatever type of media you want. Your journal can be handwritten, typed, audio, video, blog, glog, YouTube, Facebook, Twitter, etc. If notified in a timely manner, your instructor can help to set you up with an electronic site if you need a place to post your materials. There will also be a dropbox in the final exam folder that allows for giant-sized submissions.

5. Find a local environmental issue (“local” can be defined by you) that you feel strongly about. Think about your worldview and determine what your view on the issue is. Make a plan to advocate for your viewpoint and engage a group of people in this issue. Consider the following points, though you do not need to limit yourself to them:
 - a. Who would you want to communicate with about this issue?
 - b. Briefly describe any local groups that are already working on this issue. How large are these groups? How do they communicate their information? Is there any other important information on these groups? State whether your views are aligned or not with each of these groups.
 - c. Provide a “document” of some sort that you would use to distribute information. It should describe the issue, what you want them to know, what action you want them to take. Include data and sources if pertinent.
 - d. State how you would communicate your views to your audience, and why you would choose to communicate this way.
 - e. State how you would engage your audience, and why you would choose to engage them in this way.

NOTE: You may use any type of media available, as stated in the note for Question 4. Please adhere to the respectful rules of conduct used in our classroom while answering this question. You WILL NOT be graded on your actual viewpoint, but on how thoroughly you prepare your advocacy plan.

APPENDIX D

SOCIAL MEDIA FEEDBACK FORM

SM Feedback Form for Dissertation						
1. Section:						
	MM	DD	YYYY	HH	MM	AM/PM
Instructor 1	<input type="text"/>	/	<input type="text"/>	/	<input type="text"/>	: <input type="text"/> <input type="text"/>
Instructor 2	<input type="text"/>	/	<input type="text"/>	/	<input type="text"/>	: <input type="text"/> <input type="text"/>
2. Did anyone ask questions about how to use SM?						
<input type="radio"/> Yes						
<input type="radio"/> No						
Please provide brief description						
<input type="text"/>						
3. Did anyone bring up posts or ask questions about material posted on FB page?						
<input type="radio"/> Yes						
<input type="radio"/> No						
Please provide brief description						
<input type="text"/>						
4. Did discussion result from postings prior to class session?						
<input type="radio"/> Yes						
<input type="radio"/> No						
Please provide brief description						
<input type="text"/>						

SM Feedback Form for Dissertation

5. Was SM assignment discussed in class session?

Yes

No

Please provide brief description

6. Did anyone express concerns over using SM?

Yes

No

Please provide brief description

7. Did any topics from in class discussion result in posts or SM activity (ie electric car q/a session)?

Yes

No

Please provide brief description

8. Please note and describe any other activity in class of note regarding SM use:

9. Did anyone express benefits of using SM?

Yes

No

Please provide brief description

APPENDIX E

SOCIAL MEDIA CLASSROOM INSTRUCTIONS

Account Setup

For this class, you will be asked to set up a couple of new accounts within the first week of class. If you have problems or questions, please contact your instructor as soon as possible.

Student E-mail Account

As a student, you automatically receive a student e-mail account. There is information on the campus website to help you get your login and password.

Student Account

As a student, you automatically receive access to course management system. Though you needed to purchase a course packet, most of the course information, materials, and quizzes are provided through the system. There is information there to help you get your login and password.

Facebook Account

For this class, we will be using Facebook as a way to communicate important issues and materials with each other. You will need to use your own, or create a Facebook account. You will be required to give your account name to your instructor.

To create an account, go to www.facebook.com. On the right side of the screen are fields to fill in with your name, an e-mail address, and other information. If you have problems, please contact your instructor as soon as possible. We will be learning how to use Facebook in class, but for more information on how to use it, please visit www.facebook.com. You will need to be able to locate and post on the course's page: "The Course"

The privacy settings for the course page are restricted to Friends Only, but the posts will still post on your news feed and wall. If you do not want these posts, you need to switch your own personal privacy settings. If you do this, however, you will still be responsible for checking the Facebook page and posting according to assignment instructions.

Twitter Account

For this class we will also be using Twitter for some assignments. You will need to use your own Twitter account or create a new one. You will be required to give your account name to your instructor.

To create an account, go to www.twitter.com. On the right side of the page are fields to fill in with your name, e-mail address, etc. If you have problems, please contact your instructor as soon as possible.

The course account is set to Protect Tweets, which means that only people in the class that your instructor approves will be allowed to see class tweets. We will learn how to use Twitter in class, for more information on how to use it, visit <http://support.twitter.com/groups/31-twitter-basics>.

Code of Conduct for Facebook and Twitter Use in Class

The Code of Conduct for the campus will also apply to the class Facebook page and Twitter account. In general,

- Be respectful, courteous, and open-minded.
- Listen respectfully and give everyone space to “speak.”
- Only post things that you would bring to class or be proud to say in person.
- Post things that are worth sharing.
- Post things that are relevant to environmental science and to the class.
- You can and will have inappropriate posts removed and/or be removed from the sites if necessary.

Navigating Privacy Settings on Facebook (www.FacebookforEducators.com)

When you first set up a Facebook account, you will get default privacy settings. These settings are different for adults and people under the age of 18. Whether you are an adult or a minor, here are the steps for adjusting your privacy settings:

- Navigate to “Account” in the upper right hand corner of any page on Facebook.
- Click on the down arrow to reach the drop-down box where you’ll find “privacy settings” in blue letters.
- By clicking on those words, you will then be taken to the Choose Your Privacy Settings page, where you have the ability to control what information you share and with whom.

Once inside your privacy settings, you can review or adjust your settings for four categories: (a) Connecting on Facebook, (b) Sharing on Facebook, (c) Apps & Websites, and (d) Block Lists. Below we explain each of the four categories briefly. For more details, including step-by-step guidance, see www.FacebookForEducators.org and for more information on privacy settings, see www.facebook.com/settings/?tab=privacy

Connecting on Facebook: The “Connecting on Facebook” section controls who can see the information in your profile, and how people can find and connect with you on Facebook. From this page you can use the “Preview My Profile” tool, which shows you how your profile will appear to people who aren’t your Facebook friends and specific friends whose name you enter.

Sharing on Facebook: In the “Sharing on Facebook” section, there are nine general areas to help you set whom has access to information about you and what you share. Here you have the choice to set your privacy to “Everyone,” “Friends of Friends,” “Friends Only,” “Recommended” (which is the default setting), or “Custom.” We recommend your students choose the “Friends Only” setting.

Apps and Websites: This section controls what information is shared with the companies who create Facebook apps (e.g., games like Farmville). It also controls what other websites, including search engines like Google, can find out about you. You can view your apps, remove any you don’t want to use, or turn off the platform completely.

Block Lists: This section lets you block people from interacting with you or seeing your information on Facebook. You can also choose to ignore app invites from specific friends, as well as see a list of apps and people that you’ve blocked from accessing your information and contacting you.

APPENDIX F

CLIMATE ATTITUDE SURVEY

1. Recently, you may have noticed that global warming has been getting some attention in the news. Global warming refers to the idea that the world's average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world's climate may change as a result. What do you think? Do you think global warming is happening?

1. Yes
2. No
3. Don't know

1a. How sure are you that global warming is happening? [Ask if Q1=1]

1. Extremely sure
2. Very sure
3. Somewhat sure
4. Not at all sure

1b. How sure are you that global warming is not happening? [Ask if Q1=2]

1. Extremely sure
2. Very sure
3. Somewhat sure
4. Not at all sure

2. Assuming global warming is happening, do you think it is...

1. Caused mostly by human activities
2. Caused mostly by natural changes in the environment
3. None of the above because global warming isn't happening
4. Other (please specify)

3. Which comes closer to your own view?

1. Most scientists think global warming is happening.
2. Most scientists think global warming is not happening.
3. There is a lot of disagreement among scientists about whether or not global warming is happening.
4. Don't know enough to say

4. How much do you think global warming will harm you personally?

1. Not at all
2. Only a little
3. A moderate amount
4. A great deal
5. Don't know

5. How much do you think global warming will harm future generations?

1. Not at all
2. Only a little
3. A moderate amount
4. A great deal
5. Don't know

6. How much do you think global warming will harm plant & animal species?

1. Not at all
2. Only a little
3. A moderate amount
4. A great deal
5. Don't know

7. When do you think global warming will start to harm people in the United States?
They are being harmed now

1. 10 years
2. 25 years
3. 50 years
4. 100 years
5. Never

8. Which of the following statements comes closest to your view?

1. Global warming isn't happening.
2. Humans can't reduce global warming, even if it is happening.
3. Humans could reduce global warming, but people aren't willing to change their behavior, so we're not going to.
4. Humans could reduce global warming, but it's unclear at this point whether we will do what's needed.
5. Humans can reduce global warming, and we are going to do so successfully.

9. The actions of a single individual won't make any difference in global warming.

1. Strongly disagree
2. Somewhat disagree
3. Somewhat agree
4. Strongly agree

10. New technologies can solve global warming, without individuals having to make big changes in their lives.

1. Strongly Disagree
2. Somewhat Disagree
3. Somewhat Agree
4. Strongly Agree

[Q11 through 13 skipped if respondent is very or extremely sure that global warming is not occurring.]

11. Think back to the energy-saving actions you're already doing and those you'd like to do over the next 12 months. If you did most of these things, how much do you think it would reduce your personal contribution to global warming?

1. Not at all
2. A little
3. Some
4. A lot

12. If most people in the United States did these same actions, how much would it reduce global warming?

1. Not at all
2. A little
3. Some
4. A lot

13. If most people in the modern industrialized countries around the world did these same actions, how much would it reduce global warming?

1. Not at all
2. A little
3. Some
4. A lot

14. On a scale from -3 (Very Bad) to +3 (Very Good) do you think global warming is a bad thing or a good thing?

+3 (very good), +2, +1, 0, -1, -2, -3 (very bad)

15. How worried are you about global warming?

1. Very worried
2. Somewhat worried
3. Not very worried
4. Not at all worried

16. How much had you thought about global warming before today?

1. A lot
2. Some
3. A little
4. Not at all

17. On some issues people feel that they have all the information they need in order to form a firm opinion, while on other issues they would like more information before making up their mind. For global warming, where would you place yourself?

1. I need a lot more information
2. I need some more information
3. I need a little more information
4. I do not need any more information

18. How important is the issue of global warming to you personally?

1. Not at all important
2. Not too important
3. Somewhat important
4. Very important
5. Extremely important

19. How much do you agree or disagree with the following statement: "I could easily change my mind about global warming."

1. Strongly agree
2. Somewhat agree
3. Somewhat disagree
4. Strongly disagree

20. How much do you agree or disagree with the following statement: “I have personally experienced the effects of global warming.”

1. Strongly agree
2. Somewhat agree
3. Somewhat disagree
4. Strongly disagree

21. How often do you discuss global warming with your family and friends?

1. Never
2. Rarely
3. Occasionally
4. Very often

22. How many of your friends share your views on global warming?

1. None
2. A few
3. Some
4. Most
5. All

23. Over the past 12 months, how often have you contacted government officials to urge them to take action to reduce global warming via the following:

	Many times (6+)	Several times (4-5)	A few times (2-3)	Once	Never	Don't know
Written letter						
E-mail						
Social media						
Phone						

24. Over the past 12 months, how often have you rewarded companies that are taking steps to reduce global warming by buying their products?

1. Many times (6+)
2. Several times (4-5)
3. A few times (2-3)
4. Once
5. Never
6. Don't know

25. Over the past 12 months, how often have you punished companies that are opposing steps to reduce global warming by NOT buying their products?

1. Many times (6+)
2. Several times (4-5)
3. A few times (2-3)
4. Once
5. Never
6. Don't know

26. Over the next 12 months, do you intend to buy the products of companies that are taking steps to reduce global warming...

1. More frequently
2. Less frequently
3. About the same

27. Over the next 12 months, would you like to punish companies that are opposing steps to reduce global warming by NOT buying their products...

1. More frequently
2. Less frequently
3. About the same

28. In the winter, how often do you set the thermostat to 68 degrees or cooler?

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always
6. Not applicable

28a. Over the next 12 months, would you like to turn down the thermostat in winter to 68 degrees or cooler?

1. More frequently
2. Less frequently
3. About the same

29. How often do you use public transportation or car pool?

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always
6. Not applicable

29a. Over the next 12 months, would you like to use public transportation or car pool...

1. Less frequently
2. About the same
3. More frequently

30. How often do you walk or bike instead of driving?

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always
6. Not applicable

30a. Over the next 12 months, would you like to walk or bike instead of driving...

1. More frequently
2. Less frequently
3. About the same

31. How many of the light bulbs in your home are energy-efficient compact fluorescents (CFLs) or light emitting diodes (LEDs)?

1. None
2. A few
3. Some
4. Most
5. All
6. Don't know

[Asked if Q31 = Some, A few, or None]

31a. Over the next 12 months, how likely are you to change most of the light bulbs in your home to energy-efficient compact fluorescent lights (CFLs) or light emitting diodes (LEDs)?

1. Yes, I'd like to and I probably will
2. Yes, I'd like to but probably won't
3. No
4. Don't know

32. Do you think global warming should be a low, medium, high, or very high priority for the next president and Congress?

1. Low
2. Medium
3. High
4. Very High

33. Do you think corporations and industry should be doing more or less to address global warming?

1. Much less
2. Less
3. Currently doing the right amount
4. More
5. Much more

34. Do you think citizens themselves should be doing more or less to address global warming?

1. Much less
2. Less
3. Currently doing the right amount
4. More
5. Much more

35. How big an effort should the United States make to reduce global warming?

1. No effort
2. A small-scale effort, even if it has small economic costs
3. A medium-scale effort, even if it has moderate economic costs
4. A large-scale effort, even if it has large economic costs

36. People disagree whether the United States should reduce greenhouse gas emissions on its own or make reductions only if other countries do too. Which of the following statements comes closest to your own point of view?

1. The United States should reduce its greenhouse gas emissions ...
2. Regardless of what other countries do
3. Only if other industrialized countries (such as England, German, and Japan) reduce their emissions
4. Only if other industrialized and developing countries (such as China, India, and Brazil) reduce their emissions
5. The US should not reduce its emissions
6. Don't know

37. Over the past 12 months, how many times have you done these things?

	Many times (6+)	Several times (4-5)	A few times (2-3)	Once	Never	Don't know
Volunteer with or donated money to an organization working to reduce global warming						
Post a comment online in response to a news stories or blog about global warming						
Write letters, e-mail, social media posts, or phone government officials about global warming						

38. Over the next 12 months, would you like to do the following...

	More often	About the same	Less often
Volunteer with or donated money to an organization working to reduce global warming			
Post a comment online in response to a news stories or blog about global warming			
Write letters, e-mail, social media posts, or phone government officials about global warming			

39. How often do you use each of the following?

	Very often	Often	Sometimes	Hardly ever	Never
E-mail					
Text messaging					
Social networking sites (Facebook, MySpace, Tumblr, etc.)					
Blogs					
Twitter					
YouTube					

40. Here are some environmental issues now being discussed in Washington, D.C. Do you think each of these issues should be a low, medium, high, or very high priority for the next president and Congress?

	Very high	High	Medium	Low
Water pollution				
Global warming				
Toxic waste				
Damage to Earth's ozone layer				
Air pollution				
Loss of tropical rainforests				
Extinction of plant and animal species				
Urban sprawl and loss of open spaces				
Acid rain				

41. There are many reasons why people do not write letters, e-mails, call, or use social media to contact their elected officials about global warming. Which of the following reasons might prevent you from taking these actions? Please check all that apply.

1. I am not an activist
2. It wouldn't make any difference if I did
3. I don't know how
4. I'm too busy
5. It's too much effort
6. I don't think it's important
7. I would feel uncomfortable
8. I do not believe in global warming
9. Someone else in my home would object
10. None of the above would prevent me from doing this
11. Other (please specify)

42. How much do you trust or distrust the following as a source of information about global warming?

	Strongly trust	Somewhat trust	Somewhat distrust	Strongly distrust
The National Oceanic and Atmospheric Administration				
Scientists				
The U.S. Environmental Protection Agency				
The U.S. Centers for Disease Control & Prevention				
The National Park Service				
The U.S. Department of Energy				
The President				
Television weather reporters				
The mainstream news media				
Internet sources				
Your U.S. Congressperson				

43. Are you male or female?

- Male
- Female

44. Which category below includes your age?

- 18-20
- 21-29
- 30-39
- 40-49
- 50-59
- 60 or older

45. Which of the following categories best describes your employment status? (check all that apply)

- Full-time student
- Part-time student
- Employed, working 1 to 39 hours per week
- Employed, working 40 or more hours per week
- Not employed, looking for work
- Not employed, NOT looking for work
- Retired
- Disabled, not able to work

46. What is the highest level of school you have completed or the highest degree you have received?

- Less than high school degree
- High school degree or equivalent (e.g., GED) Some college but no degree
- Associate degree
- Bachelor degree
- Graduate degree

47. Are you White, Black or African-American, American Indian or Alaskan Native, Asian, Native Hawaiian or other Pacific islander, or some other race?

- White
- Black or African-American American Indian or Alaskan Native Asian
- Native Hawaiian or other Pacific Islander
- From multiple races
- Some other race (please specify)

48. Are you a member of any of the following types of groups?

- AARP
- Labor union
- Parent-Teacher association (PTA)
- Veteran s association
- Religious study group/Church group/Church board
- Service club or fraternal organization, such as Rotary, Optimists, Elks, etc.
- Animal rights organization
- YMCA
- Environmental organization
- Chamber of Commerce
- Other (please specify)

49. Describe your access to the following technologies

	Own	Rent	Borrow	Library/school
Desktop computer				
Laptop computer				
Tablet/iPad				
Smart phone				
Cell phone				
Other (please specify)				

APPENDIX G

CONTENT KNOWLEDGE TEST

1. Environmental issues are typically
 - A) nonpolitical.
 - B) very political.
 - C) initiated by politicians.
 - D) settled mainly by professionals with little government input.
2. The real success and importance of environmental legal actions is in
 - A) ensuring that those guilty of environmentally wrongful acts are punished.
 - B) preventing environmental damage from occurring.
 - C) identifying those responsible for environmentally harmful acts.
 - D) recovering individual damages after environmentally wrongful acts are committed.
3. Corporate behavior is largely determined by which of the following?
 - A) societal needs
 - B) ethical standards
 - C) profitability
 - D) consumer needs
4. Some of the major areas of responsibility for the Federal Environmental Protection Agency (EPA) include
 - A) urban housing.
 - B) air and water management.
 - C) transportation.
 - D) congressional reform.
5. Which of the following is likely to occur if the world's population doubles?
 - A) Extinctions will increase as natural areas are destroyed for more houses and agriculture.
 - B) Oceans will supply a majority of the food.
 - C) Natural ecosystems will remain unchanged.
 - D) More cattle will be grown to feed the population.
6. Which of the following is/are environmental problem(s) associated with coal as a fuel?
 - A) strip mining disfiguring the land
 - B) air pollution
 - C) black lung disease
 - D) all of the above

7. Rising dependence on oil as a major energy source is likely to create
- A) eventual shortage since it is a nonrenewable resource.
 - B) increases in radioactivity.
 - C) little risk in coastal oil drilling areas to environmental problems.
 - D) less air pollution.
8. Home energy savings can be increased by
- A) sealing air leaks.
 - B) lowering the temperature in the summer and raising it in the winter.
 - C) leaving lights on 24 hours/day.
 - D) all of the above.
9. Which is potentially the most serious environmental concern associated with nuclear power plants?
- A) core meltdown
 - B) ground water pollution
 - C) thermal pollution
 - D) toxic fish
10. Which of the following has the lowest potential for a negative (harmful) environmental impact? (i.e., Which source is the safest for the environment?)
- A) coal
 - B) oil
 - C) conventional nuclear fission
 - D) passive solar
11. Which one of the following is not generally considered part of organic farming techniques?
- A) crop rotation
 - B) use of synthetic insecticides
 - C) use of manure
 - D) conventional cultivation
12. At the present time,
- A) the forests of the world are being used at or above capacity.
 - B) worldwide forest resources are being only slightly used.
 - C) most industrialized countries have an abundant forest supply.
 - D) the forests of most regions are self-sustaining.
13. Having a defective radio repaired rather than buying a new one would be an example of
- A) rubbish.
 - B) recycling.
 - C) urban waste.
 - D) reuse.

14. Which of the following is most likely to be persistent in the environment?
- A) PCBs
 - B) organophosphate pesticides
 - C) garbage
 - D) noise
15. Which method of handling solid waste saves energy and best conserves natural resources?
- A) recycling
 - B) sanitary landfill
 - C) incineration
 - D) ocean dumping
16. Synergism, or synergistic effects, are
- A) the effects of a pollutant in all of its various forms.
 - B) household materials that can be pollutants.
 - C) combinations of pollutants that are more harmful than the individual pollutants.
 - D) the results of pollution over long periods of time.
17. Depletion of the protective ozone layer surrounding the earth is being caused by which pollutant?
- A) carbon dioxide
 - B) chloro-fluorocarbons
 - C) sulfur dioxide
 - D) nitrogen oxides
18. The most significant cause of chronic respiratory disease in the United States is
- A) chloro-fluorocarbons.
 - B) carbon monoxide.
 - C) tobacco smoke.
 - D) carbon dioxide.
19. Significant increases in atmospheric carbon dioxide have resulted from
- A) the release of heat when any form of energy is used.
 - B) the evaporation and subsequent condensation of seawater.
 - C) photosynthesis in terrestrial and aquatic plants.
 - D) deforestation, fossil fuel burning, and wood burning.
20. Increasing the nutrients entering a waterway
- A) increases water quality for drinking purposes.
 - B) increases the amount of fish that will inhabit the area.
 - C) decreases water pollution.
 - D) stimulates algae and plant growth.

21. In environmental policy-making decisions, a method used for determining whether a policy generates more social costs than social benefits is called a
- A) decision framework.
 - B) net effect analysis.
 - C) cost protocol analysis.
 - D) cost-benefit analysis.
22. Using a resource today to meet a current need without compromising future generations' ability to meet their need is called
- A) sustainability.
 - B) corporate ethics.
 - C) ecological perspective.
 - D) economic development.
23. Putting political differences aside, nations worldwide banning the use of CFCs to prevent further damage to the ozone is an example of
- A) global ethics.
 - B) individual ethics.
 - C) conservation ethics.
 - D) societal ethics.
24. If one wishes to compare the health risks of living next to a toxic waste incinerator to being a cigarette smoker, we would need to consider the
- A) supply and demand of tobacco.
 - B) economic value of incinerators.
 - C) impact of nuclear power in the U.S.
 - D) true and perceived risks of both situations.
25. What is the difference between drinking water and wastewater treatment?
- A) Only drinking water adheres to primary (health) standards.
 - B) Drinking water treatment treats water associated with human sewage, and wastewater treatment treats water that is used in laundry, dishwashers, etc. (other wastewater).
 - C) Drinking water treatment treats water to be sent to houses for use. Wastewater treatment is for water that come from sewers.
 - D) Drinking water treatment requires more biological steps than wastewater treatment.
 - E) all of the above
26. Which is the "best" choice for reducing solid wastes?
- A) growing all of your own food, and not buying it from a store
 - B) choosing multiple small containers that are in one larger box, all wrapped together in plastic
 - C) choosing several small, metal cans
 - D) choosing a bulk item with a thin plastic packaging

27. A city's wastes are
- A) almost completely removed and hauled to landfills or incinerators.
 - B) are turned into a source of food for humans.
 - C) decomposed entirely within a city's boundaries by masses of decomposers.
 - D) are almost entirely reused or recycled within the city's boundaries (therefore, few raw materials must be brought into a city).
28. Why do environmentalists have such a difficult time associating an economic value with leaving land undeveloped?
- A) The loggers and farmers will always take most of the money from the land, so little is left for the environmentalists.
 - B) The living trees are completely worthless, but are worth something if you cut them down.
 - C) No one listens to environmentalists, so they have a hard time collecting data from scientists about the value of the land.
 - D) It is hard to put a price tag on things like ecosystem health, biodiversity, and aesthetics.
29. Which of the following can contribute to urban sprawl?
- A) American reliance on cars over public transportation
 - B) development and growth away from urban centers
 - C) the need for new, bigger, better houses
 - D) financing on new houses that is easy to obtain
 - E) all of the above may contribute
30. Which of the following is the automobile a culprit in?
- A) rising carbon dioxide levels in the atmosphere and potentially global warming
 - B) carbon monoxide pollution
 - C) rapid depletion of oil resources
 - D) nitric acid rain
 - E) all of the above
31. The "greenhouse effect" refers to
- A) the Earth's protective ozone layer.
 - B) don't know.
 - C) how plants grow.
 - D) gases in the atmosphere that trap heat.
 - E) pollution that causes acid rain.

32. Which of the following gases in the atmosphere are good at trapping heat from the Earth's surface? Check all that apply
- A) Methane
 - B) Water vapor
 - C) Oxygen
 - D) Hydrogen
 - E) Carbon dioxide
33. What gas is produced by the burning of fossil fuels?
- A) oxygen
 - B) helium
 - C) carbon dioxide
 - D) don't know
 - E) hydrogen
34. On average, how long does carbon dioxide stay in the atmosphere once it has been emitted?
- A) a few days
 - B) a few years
 - C) a hundred years
 - D) a million years
 - E) don't know
35. Which picture best represents your understanding of how the amount of carbon dioxide in the atmosphere has changed over the past 500 years?
- A) Graph a—no change
 - B) Graph b—linear increase
 - C) Graph c—linear decrease
 - D) Graph d—exponential increase
 - E) Graph e—exponential decrease
 - F) don't know
36. Which of the following are true statements? Check all that apply.
- A) Scientists can't predict the weather more than a few days in advance—they can't possibly predict the climate of the future.
 - B) Scientists' computer models are too unreliable to predict the climate of the future.
 - C) Global warming will cause some places to get wetter, while others will get drier.
 - D) Global warming will cause temperatures to increase by roughly the same amount in all countries.
 - E) Global warming will increase crop yields in some places and decrease it in others.

37. Which of the following contribute to global warming in some way? Check all that apply.

- A) toxic wastes
- B) nuclear power plants
- C) cows
- D) earthquakes
- E) deforestation
- F) volcanic eruptions
- G) the hole in the ozone layer
- H) acid rain
- I) the space program
- J) cars and trucks
- K) the amount of dust in the atmosphere
- L) sunspots
- M) greenhouse gases in the atmosphere
- N) aerosol spray cans
- O) burning fossil fuels for heat and electricity

38. Which of the following are “fossil fuels”? Check all that apply.

- A) oil
- B) coal
- C) natural gas
- D) solar energy
- E) wood
- F) hydrogen

APPENDIX H
SELF-REPORT QUESTIONS

1. How much did you know about this subject before this unit? Likert scale 1-5
(nothing, a little, some, a lot but could not explain to others, a lot and could explain to others)
2. Did this unit impact or change your thinking about this subject? Y/N
3. In what way did this unit impact or change your thinking about the subject? [fill in blank]
4. Did you engage in any of the following activities as a result of this unit? [check box, plus other fill in blank]
 - Writing a letter to the editor
 - Writing to your congressperson
 - Signing a petition
 - Making different shopping choices
 - Discussing with friends and family
 - Volunteering with an organization or for an event
 - Seeking additional information about this topic
 - Sharing information using social media
 - Sharing information using traditional media
 - Reducing your impact (i.e. recycling, shorten shower, use public transportation, reduce waste)
 - Other

APPENDIX I

INTERVIEW PROTOCOL

The interview will begin with a brief introduction of the study, which focuses on the use of Social Media (SM) as an engagement tool. The interviewee will be reminded of confidentiality and asked for permission to digitally record the session for transcription purposes. Before we get started, I would like to confirm that you give permission to digitally record this interview.

— Background Information

- Basic Biographical: (name, age – if agreeable)
- Background Factual: years, degrees, institutions
 - What year are you at Community College?
 - Do you hold a degree from another institution, if so where?
 - What is your purpose for taking this course (fulfill requirement, interested in subject, other)?
 - What are your long-term education goals (degree, self-education, certificate program)?

— Social Media Usage

- What types of SM did you use at the start of the semester?
- What types of SM do you use now?
- How often do you use FB?
- How often do you use Twitter?
- How often do you use YouTube
- Do you use specific SM for specific purposes?

— Can you comment, in general, about your experience with using SM as part of this course? Please elaborate. [Might have some follow-up and probing questions]

— How do you define public engagement?

— What impact, if any, did this course have on your sense of public engagement?

— What impact, if any, did this course have on your willingness to express your environmental values and stand for issues that are important to you?

— What actions, if any, have you taken to express your environmental values as a result of this course? Please give an example.

— What, if any, impact did the use of SM in this course have on your communication activities?

— What, if any, impact did the use of SM in this course have on your sense of public engagement?

- What, if any, impact did the use of SM in this course have on your learning about environmental issues?
- What are your impressions about the use of SM in this course?
- Do you think the use of SM in this course impacted your interaction with your fellow students? Please explain.
- Did you share information you learned in this course with friends, family, others? Please give an example.
- Did you use SM to share information from this course with friends, family, fellow students, others? Please give an example.
- Did the use of SM in this course change how you interacted with the course material?
- What did you enjoy most about using SM in this course?
- What did you find challenging about using SM in this course?
- What recommendations would you make for future classes using SM?
- Do you have any additional comments, observations, or suggestions you would like to share with me?

APPENDIX J

ENGAGEMENT SCORING RUBRIC

Question 4. PERSONAL ACTION PLAN

Make a personal action plan toward a more sustainable daily life. Begin by going through your footprints from class and assessing where you could make changes and reduce your impact. Once you make your plan, DO IT for at least three consecutive days (at least one a business day). Keep a journal of your daily activities and where you decided to reduce. For the exam, bring both your journal and personal action plan, and summarize each. Also reflect on your experience for the exam: What was easy, challenging, rewarding, etc.?

NOTE: You may use whatever type of media you want. Your journal can be handwritten, typed, audio, video, blog, glog, YouTube, Facebook, Twitter, etc. If notified in a timely manner, your instructor can help to set you up with an electronic site if you need a place to post your materials. There will also be a dropbox in the final exam folder that allows for giant-sized submissions.

Category	Points	Comments
Choice to use SM in personal action plan (5 pts.)		
Summary of actions using SM from journal (5 pts.)		
Summary of experience (5 pts.)		
Indicators of public engagement (5 pts.)		
Engagement of others in plan (5 pts.)		

Total: ___/25

Question 5. ENVIRONMENTAL ISSUE ENGAGEMENT CAMPAIGN

Find a local environmental issue (“local” can be defined by you) that you feel strongly about. Think about your worldview and determine what your view on the issue is. Make a plan to advocate for your viewpoint and engage a group of people in this issue. Consider the following points, though you do not need to limit yourself to them: Who communicate with, Who is working on the issue, What will you distribute, How will you communicate your views, and How would you engage your audience. For the exam, bring both your information about the issue, your one-page write up, and your engagement plan. Also reflect on your experience for the exam: What was easy, challenging, rewarding, etc.?

You may use any type of media available, as stated in the note for Question 4. Please adhere to the respectful rules of conduct used in our classroom while answering this question. You WILL NOT be graded on your actual viewpoint, but on how thoroughly you prepare your advocacy plan.

Category	Points	Comments
SM use to engage others (5 pts.)		
SM use to determine who is working on issue (5 pts.)		
SM distribution and creation of materials (5 pts.)		
Summary of experience (5 pts.)		
Indicators of public engagement (5 pts.)		
Thorough understanding of assignment/approach (5 pts.)		

Total: ___/30