

Constructing Media Artifacts in a Social Constructivist Learning Environment to
Enhance Students' Environmental Awareness and Activism

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Dedication

This thesis is dedicated to my grandparents.

Abstract

Current science education reforms and policy documents highlight the importance of social awareness and activism in solving environmental problems. “Environmental problems are socially constructed in terms of their conceptualized effects on individuals, groups, other living things and systems [. Thus,] research based on constructivist principles provides not only a coherent framework in which to theorize about learning, but also a context for understanding socially constructed issues and knowledge” (Palmer & Suggate, 2004, p. 208). This research study particularly investigated the impacts of two constructivism-based frameworks, constructionism and social constructivism, on students’ environmental awareness and activism, and their motivation and engagement. Students constructed media artifacts to reflect their knowledge, attitudes, awareness, and activism about environmental issues through a constructionist design process. Additionally, social networking technologies were integrated into the process to improve the effectiveness of the frameworks employed in this study.

A convergent mixed methods design was implemented for this research to triangulate the methods by directly comparing and contrasting quantitative results with qualitative findings for corroboration and validation purposes. Twenty-two 10th to 12th graders were recruited from their environmental science class to participate in this study. The findings of the study indicated that students’ environmental awareness and activism were improved throughout the constructionist and social constructivist learning processes. In addition, constructionist and social constructivist methods and tools such as

video designing activities and social networking website positively affected student motivation and engagement.

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Chapter I: Introduction

Rationale

Current science education reforms around the world promote students' understanding of science concepts and the application of their understanding to solving real world problems, which is usually entitled as scientific literacy including aspects of social awareness and social activism (Lester, Ma, Lee, & Lambert, 2006). Social awareness and social activism are two different concepts sometimes considered and used for similar purposes. Littledyke (2008) described social awareness as how people interact with others socially to influence individual choices whereas social activism requires both taking responsibility and action in solving societal problems and influencing the decisions and actions of others (Bouillion & Gomez, 2001; Fusco, 2001; Rahm, 2002). It was argued that the public needs to understand social and environmental issues before they will take action (Hansen, 2000). Environmental awareness in the western world is growing as more actions are taken in favor of protecting Earth's ecosystems (McMichael, 2000). The environmental literature supports strong interactions between the awareness and action domains (Pata & Metsalu, 2008).

This study uses climate change as an important component of environmental science to explore the interactions between social/environmental awareness and activism. Climate change is particularly appropriate to examine students' social awareness and activism because this particular environmental issue is being accelerated by human activities and thus can be mitigated by individual and social human actions (Rosenthal, 1990). In addition, "environmental problems are socially constructed in terms of their conceptualized effects on individuals, groups, other living things and systems, [and

accordingly,] research based on constructivist principles provides not only a coherent framework in which to theorize about learning, but also a context for understanding socially constructed issues and knowledge” (Palmer & Suggate, 2004, p. 208). The fact that this study is grounded on two constructivist theoretical frameworks, and social constructivism, can help both learners and researchers to understand this particular environmental issue more deeply.

According to Lester et al. (2006), the importance of science in both personal and social contexts is highlighted in science education reform documents such as American Association for the Advancement of Science [AAAS] in 1989 and 1993; National Research Council [NRC] in 1996; and National Science Teachers Association [NSTA] in 1993. Although these documents report that environmental awareness and activism is one of the primary goals of science education, it has seldom been taught in schools because of a variety of reasons such as standards-based instruction and standardized assessments that favor content-focused instruction. To achieve this goal of scientific literacy and environmental awareness, students must have strong and permanent scientific content knowledge and be able to relate this knowledge to the real world application and experiences. In response to such efforts, constructionist and social constructivist methods are advocated to achieve the goal of providing meaningful learning. Both constructionism and social constructivism derive their theoretical underpinnings from Piaget’s ideas of constructivist epistemology. Beck and Kosnik (2006) stated that “All constructivists, whatever their distinctive emphasis, agree that learners construct their knowledge” (p. 9). The authors point out that social constructivism theory adds the idea that all learners of a learning community present their ideas with others, and remain open to ideas of others.

Bruckman and Resnick (1995) described the philosophy of constructionism as follows: “People learn with particular effectiveness when they are engaged in constructing personally meaningful projects; learning by doing is better than learning by being told and this approach is most often applied to children's learning” (p. 2). Most basically, constructionism organizes learning around a design process while social constructivism highlights the role of social interactions in learning.

Statement of the Problem

The primary purpose of this research study is to determine whether using the integration of constructionist and social constructivist methods improve high school students’ environmental awareness and activism related to the specific topic of global climate change. This research will provide direction and support for developers of constructionist and social constructivist learning environments to improve students’ understanding of climate change. The specific research questions that guide this study are:

1. How do constructionist and social constructivist frameworks impact students’ environmental awareness?
2. How do constructionist and social constructivist frameworks impact students’ environmental activism?
3. How do students express environmental awareness and activism throughout constructionist and social constructivist learning processes?
4. How do constructionist and social constructivist frameworks affect students’ motivation and engagement?

Significance of the Study

According to several educational reports (e.g. AAAS, 1989, 1993; NRC, 1996; NSTA, 1993; Organization for Economic Cooperation and Development's [OECD], 1998; Ministry of Education New Zealand 1993; National Committee on Science Education Standards and Assessment 1996; House of Lords 2000; House of Commons Science & Technology Committee 2002; Turkish Ministry of Education [MEB], 2005), social awareness and activism are important components of scientific literacy and one of the ultimate goals of science education, but they have seldom been the focus of instruction in schools. Science education literature needs more research showing both the necessity of awareness and activism for science education and the effective methods to teach them. Lester et al. (2006) indicated that there is almost no research in the science education literature on the role of social activism in solving environmental problems, and there is very little in the literature concerning student activism and its relationship to conceptual knowledge. Correspondingly, several research results show that student activism in the United States has been declining for decades (Apple, 2000; Giroux, 2002). In addition to examining students' understanding, awareness, and action with regard to societal and environmental issues such as climate change, it is also valuable to examine the relationship between these three aspects. As Pata and Zimdin (2008) stated:

Most of the studies investigating the effectiveness of environmental education do not deal with the real environmental problem-solving situations, but ask about knowledge, values, awareness that the students claim to have, and the activities they claim to do; thus, if awareness was studied with the questionnaires, rather

than measuring awareness components in action, it would only be possible to measure students' knowledge of certain awareness aspects (p.3).

Jensen (2002) found that the cognitive factors that positively influence environmental behaviors are awareness of the problem, environmental knowledge, and constructed knowledge centered on action. The results of Lester et al. (2006) study indicated that students with adequate science knowledge tended to express activism more frequently, and that their expression of activism increased as they gained better science knowledge; however, Caldarelli (2004) pointed out:

Current approaches assume that increasing a learner's environmental literacy will foster pro-environmental attitudes, which in turn will result in the adoption of environmentally responsible behavior. This approach is problematic because research studies have indicated that there are numerous psychological and sociological variables that influence, usually through synergistic relationships, the facilitation of environmentally responsible behavior (p. 5).

In addition, Evans, Gill, and Marchant (1996) emphasized that although efforts to increase students' knowledge and awareness of environmental issues are valuable and necessary, "young people will not act immediately because there is an inevitable time lag before the children or students, who are being educated, are in planning or decision-making roles" (p. 245). Although people are knowledgeable and aware of environmental issues, they are not usually ready to transfer their knowledge and awareness into action (Barraza & Walford, 2002; Tuohino, 2003). Since this study is grounded on social interactions and designing artifacts that reflect students' understanding, awareness, and action; it can give stronger, more meaningful and more reliable evidence about the

development of student understanding, environmental awareness and activism about environmental issues such as climate change. Therefore, this study can be a useful source for researchers who want to examine the relationship between scientific knowledge, awareness, and action domains.

Both Barraza and Walford (2002) and Jinliang et al. (2004) emphasized that students' awareness, attitudes and understandings are mainly influenced by media coverage. Also, Hodson (2003) stated that the policy documents such as National Science Board in 1998 and Select Committee in 2000 reported that most people obtain their knowledge of contemporary science and its applications in societal issues from televisions and newspapers. He added that the capacity for active critical engagement with text is a crucial and even fundamental element to understand the science related issues in real world. In addition, Jinliang et al. (2004)'s study showed that students' environmental knowledge derives from TV, the press, teachers, and parents, in this order.

More recently, the trend of traditional media such as television and newspapers has shifted to the more innovative media, such as social networks (Pempek, Yermolayeva, & Calvert, 2009). Recently, social media and social networks have become important resources for any field, including environmental science. It is fair to assume that social media and networks affect students' awareness, attitudes, and understandings just like any other kind of media. A nationally representative survey of U.S. youth indicated that 41% of 12-13 year olds and 61% of 14-17 year olds use social networking sites (Lenhart & Madden, 2007). The same study showed that about half of 12-17 year olds with social networking site membership log on daily: 22% logged on to social networking sites several times per day, 26% once a day, 17% three to five days per week,

15% one or two days per week, and only 20% every few weeks or less. In addition, according to a recent survey, 48% of young Americans say they find out about news through Facebook, one of the most popular and widely used social media all around the world (<http://www.onlineschools.org/blog/facebook-obsession/>). Thus, the urgency to integrate social networks into the learning process aiming students to gain more permanent and meaningful knowledge and attitudes in terms of environmental problems. Thus, this study also provides an opportunity for instructors, researchers, and other educators to explore the use of social networks for environmental education purposes.

Definitions of the Terms

To provide a common base of understanding, the following definitions are included:

Constructionism is a philosophy and framework for learning and an educative action developed by Seymour Papert, Idit Harel and colleagues at the MIT Media Lab in the 1970s and 1980s. Idit Harel described the theory of constructionism as ‘children learn best when they are in the active roles of designer and constructor’. Papert (1986) defined his theory in a proposal to the National Science Foundation entitled constructionism: A New Opportunity for Elementary Science Education as follows:

The word constructionism is a mnemonic for two aspects of the theory of science education underlying this project. From constructivist theories of psychology, a view of learning as a reconstruction rather than as a transmission of knowledge is taken. Then, we extend the idea of manipulative materials to the idea that learning is most effective when part of an activity the learner experiences as constructing a meaningful product.

Social constructivism is a theory first defined by a well-known scientist, Lev Vygotsky who believed that language, mental, and social development is supported and enhanced by others through social interactions (Mathis, 2011). Kim (2001) described social constructivism theory as a social process where meaningful learning occurs in case individuals are engaged in social activities.

Social awareness is defined in many different ways in the literature. According to Prasolova-Forland (2002), in one group of definition, social awareness is defined as awareness about the social situation of other people whereas the second group's definition indicates that social awareness is awareness about the social connections within a group. Based on these two groups of definitions, she concluded that "Social awareness is awareness of the social situation in a group or community in a shared environment, which can be physical, virtual or both: people's roles, activities, positions, status, responsibilities, social connections and group processes" (p. 1).

Environmental awareness is the growth and development of awareness, understanding, and consciousness toward the biophysical environment and the problems occurring in it, including human interactions and effects (North, 1997).

Social activism was described by Lester et al. (2006) as follows: "Social activism is not only taking personal responsibility and actions in solving societal problems, but also influencing the actions of others including parents, friends, relatives, neighbors, or local businesses" (p. 315-316).

Social networking sites are designed in order to promote social interaction among the members in a virtual online environment. Pempek, Yermolayeva, and Calvert (2009) wrote that communication is facilitated through information posted in the profile, which

provides information about one's identity, and it is provided through various applications similar to email or online message boards.

Climate Change is a regional change in temperature and weather patterns.

According to the Intergovernmental Panel on Climate Change (IPCC TAR, 2001) Third Assessment Report, Climate change refers to

a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer).

Climate change may result from natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or inland use. Note that United Nations Framework Convention on Climate Change, in its Article 1, defines "climate change" as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". United Nations Framework Convention on Climate Change thus makes a distinction between "climate change" attributable to human activities altering the atmospheric composition, and "climate variability" attributable to natural causes (p. 711).

Overview of the Following Chapters

The next chapter, Chapter II, includes a review of literature in areas related to this study. The first part, *Constructionism*, discusses the theoretical and historical background, definitions, and components of the constructionism theory generated by well-known researchers in the field. The second part, *Social Constructivism*, provides an overview of the social constructivism theory and its development process. The third part,

Social Networks in Education, focuses on the use of social networks in education field. The last part, *Social/ Environmental Awareness and Activism*, provides the descriptions of the social awareness, environmental awareness, social activism, and environmental activism. The role of awareness and activism in environmental education, scientific literacy, and science-technology-society movement is discussed in this part.

Chapter III provides information about research methods employed in this study. It illustrates the research design, the study context and participants, the instructional intervention, and the data collection and analysis procedures.

In Chapter IV, the findings that emerged from each data source were shared. Then, these findings were presented together.

Chapter V includes the discussion of the findings, implications, and suggestions for researchers and instructors.

Chapter II: The Review of Literature

This chapter reviews the theories and literature on which this study is grounded. The first section includes the definitions, theoretical background, and different perspectives of constructionism theory. It provides a broad overview of the theory, its development in education field, and uses of the theory. The second section describes social constructivism theory which is second framework employed in this study. The last section provides a discussion about social and environmental awareness and its place in developing scientific literacy and environmental education.

Constructionism

Constructionism is a philosophy and framework for learning and an educative action developed by Seymour Papert, Idit Harel and colleagues at the MIT Media Lab in the 1970s and 1980s (Reynolds & Harel Caperton, 2009). The theory of constructionism became well known through Papert's grant application to the National Science Foundation called *Constructionism: A New Opportunity for Elementary Science Education* (Macdonald & Hoban, 2009). Constructionism is being accepted as both a learning theory and instructional strategy (Han & Bhattacharya, 2001), and was considered a new learning approach and pedagogy in the 1990s. Papert considered education as having two different dimensions, which can be called informational and constructional (Papert, 1999). He added that one view of learning is about getting knowledge as a passive receiver, while the other view is doing things, making things, and constructing things as active participant.

Seymour Papert, a protégé of the famous developmental psychologist Jean Piaget, was concerned with children's transition from Piaget's concrete to abstract stages

(Maxwell, 2003). Even though the root of constructionism comes from constructivism, Papert (1991) defined his theory in two stages to distinguish his theory from constructivism. The internal stage is an active process where students construct their knowledge from their experiences in the world, and the external stage is based on the idea that student learning is most effective when they design artifacts and share with others. Macdonald and Hoban (2009) stated that “Constructionism draws from both Piaget’s individual notion of constructivism (von Glaserfeld, 1984, 1987, 1989) and Vygotsky’s notion of social influence on learning (Vygotsky, 1978, 1986)” (p. 5). Ackermann (2001) stated that “Whether grounded in action as in Piaget’s theory, or mediated through language as in Vygotsky’s, most constructivist models of human intelligence remain essentially science-centered and logic-oriented —and so does Papert yet to a lesser extent” (p.6). Harel (1991), a student of Papert, added three important points that makes Papert’s idea unique. Her first argument was that constructionism is far more involved in cognitive development through the process of learning. Second, constructionist learning environments are also technologically richer than Piaget’s learning environment. Lastly, Papert’s theory is more focused on individual differences. Ackermann (2010) pointed out that “both Papert and Vygotsky shed light on the articulations between direct and mediated experience (from action and tool-use to enactments, language, and symbol-use)” (p. 1). Similar to Papert, Vygotsky spent his entire life studying the role of cultural artifacts as a resource for drawing the best out of every person’s cognitive potential. Stager (2003) stated that the idea of constructionism “extends Piaget’s notion of constructivist learning by stating that the key way to ensuring learning is through the act of constructing something outside of one’s head” (p. 1). Papert (1990) himself extended

that to “something external or at least shareable ... a sand castle, a machine, a computer program, a book” (p. 3). Constructionism theory argues that individuals learn best when they are constructing an artifact that can be shared with others and reflected upon (Grant, 2002; Harel & Papert, 1991), and these artifacts can be anything from a poem, an internet posting, a poster, or a short video to more complex artifacts like a computer game or a software program.

Learners in a constructionist learning environment are more likely to explore and to make deep connections with subject areas (Resnick & Ocho, 1991). Papert (1999) stated that “We learn best of all by the special kind of doing that consists of constructing something outside of ourselves: a child building a tower, writing a story, constructing a working robotic device or making a video game are all examples of constructing” (p.

XIII). Harel and Papert (1990) stated:

To the adage ‘you learn better by doing,’ constructionism adds the rider, ‘and best of all by thinking and talking about what you do.’ Without denying the importance of teaching, it locates the important directions of educational innovation less in developing better methods of teaching than in developing “better things to do and more powerful ways to think about what you are doing (p. 3).

They also add that a narrow description of their intention in building the theory of constructionism is to turn the tables by giving the learner the active position rather than the passive position of a recipient of knowledge; the position of designer/producer rather than consumer.

Although the theories of constructivism and constructionism have many common points, there are also some differences. Papert defined his theory in a proposal to the National Science Foundation entitled *Constructionism: A New Opportunity for Elementary Science Education* as follows: “The word constructionism is a mnemonic for two aspects of the theory of science education underlying this project. From constructivist theories of psychology, a view of learning as a reconstruction rather than as a transmission of knowledge is taken; then, we extend the idea of manipulative materials to the idea that learning is most effective when part of an activity the learner experiences as constructing a meaningful product.” Papert (1991) also explained the main similarity and difference between Piaget’s constructivism and his theory of constructionism in this way:

Constructionism—the N word as opposed to the V word— shares constructivism’s view of learning as “building knowledge structures” through progressive internalization of actions... It then adds the idea that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it’s a sand castle on the beach or a theory of the universe (p.1).

In another document, he emphasized the most important difference between the “n word” constructionism and the “v word” constructivism (Papert, 1999). He stated that the v-word refers to a theory about how every subject is learned, especially math and science, and a proposal about how they should be taught, whereas, in addition to a general principle of learning and teaching, the n-word also includes a specific content area that

was neglected in traditional schools but which is becoming a crucial knowledge area in the modern world.

According to Ackermann (2001), both Piaget and Papert view children as the builders of their own cognitive tools and external realities, which makes them constructivist. They are also developmentalists in that they define “intelligence as adaptation, or the ability to maintain a balance between stability and change, closure and openness, continuity and diversity, or, in Piaget's words, between assimilation and accommodation” (p. 7-8). On the other hand, she described the difference at a deeper level, “Piaget's interest was mainly in the construction of internal stability (*la conservation et la reorganisation des acquis*), whereas Papert is more interested in the dynamics of change (*la decouverte de nouveaute*)” (p. 8).

According to Bruckman and Resnick (1995), the theory of constructionism supports the idea that for effective learning, people need to be engaged in constructing personally meaningful artifacts or projects, and learning occurs more effectively by doing better than being told. The authors stated that the term constructionism involves two types of construction. First, constructionism claims that learning is an active process, in which people actively construct knowledge from their experiences in the world, which is based on the constructivism theory of Jean Piaget. And, to this, it specifically adds the idea that people construct new knowledge more effectively if they are engaged in constructing meaningful products for themselves and others around them.

Ackermann (2001) stated that all researchers ‘construct’ their own idealized child, and compares the ideal child of Piaget’s constructivist theory called Robinson and Papert’s constructionism in this way,

I like to think of Piaget's child as a young Robinson Crusoe in the conquest of an unpopulated yet naturally rich island. Robinson's conquest is solitary yet extremely exciting since the explorer himself is an inner driven, very curious, and independent character. The ultimate goal of his adventure is not the exploration as such, but the joy of stepping back and being able to build maps and other useful tools in order to better master and control the territory under exploration. Papert's "child," on the other hand, is more relational and likes to get in tune with others and with situations. S/he resembles what Sherry Turkle describes as a "soft" master (Turkle, 1984). Like Piaget's Robinson, s/he enjoys discovering novelties, yet unlike him, s/he likes to remain in touch with situations (people and things) for the very sake of feeling at one with them. Like Robinson, s/he learns from personal experience rather than from being told. Unlike him, s/he enjoys gaining understanding from singular cases, rather than extracting and applying general rules. S/he likes to be engaged in situations and not step back from them. S/he might be better at pointing at what s/he understands while still in context, than at telling what s/he experienced in retrospect (p. 9).

There have been strong efforts to find a widely accepted description for the theory of constructionism. Most basically, constructionist theory advocates that learning occurs when learners construct knowledge and create artifacts reflecting their knowledge; Papert and Harel (1991) used the term *learning-by-making*. Just like any constructivist researcher, Papert grounded his theory on the perception of knowledge creation as the result of active interactions with the world. In addition, he distinguished his theory as

being more effective when learners were engaged in constructing personally meaningful products (Papert, 1991).

One of the most emphasized features of constructionism is that learners design or program sharable artifacts. According to Papert, if we want students to gain a deeper understanding of something, they have to create it, construct it and build it. Design is an important point for constructionist learning processes. Constructionist researchers consider the design process as one of the most effective parts of learning. As designers, learners are given the opportunity to be creative and to become intellectual partners with technology in a constructionist learning process (Salomon, Perkins, & Globerson, 1989). To make learning more effective and motivational, it needs to result from students designing personally-meaningful artifacts (Bruckman & Resnick 1995). Newstetter (2000) added that design experiences promote discovering new ideas, and learning content. Designing artifacts and sharing them with others make learners' ideas more concrete and allow learners to establish a personal connection with new knowledge (Papert, as cited in Baytak and Land, 2011). Perkins (1986) also argued that the act of designing promotes the active and creative use of knowledge by learner as designer.

In the design process, according to Perkins, the problem's meaning is not given by the problem itself, as is a common in education today; rather, the designer explores his own meanings and defines his own goals before and during the design process. In a research study, Resnick, Ocko, and Papert (1988) showed that design activities have the greatest educational value when students are given the freedom to create things that are meaningful to both themselves and other members of their learning community, and students also approach their work with more motivation and interest in such situations.

As a result, learners are more likely to explore, and to make deeper connections with the mathematical and scientific concepts that underlie the activities. Another constructionist researcher, Falbel (1991), described authentic education as something one performs for oneself; and that learning should be the emphasis instead of teaching because learning associates a more active feel, whereas teaching carries a sense of passivity.

Constructionist learning processes typically involve learners in project-based design work over time in a collaborative setting, and engages learners in design activities to build artifacts representing their ideas (Reynolds & Harel, 2011). “The Constructionist approach to education goes beyond typical hands-on activities in that it aims to give children more control over finding and defining the problems they work on” (Resnick, 1991, p. 151). However, constructionist approaches are not limited to only the design process. Papert (1980, 1990) highlighted the steps of researching, designing, and constructing an artifact or model as a representation of knowledge for learners to engage in deep learning. Constructionism, by placing a high priority on making projects personal, asserts that learners in constructionist environments who make connections with their projects always do the most creative work and gain knowledge the most from their experiences (Resnick, 1991).

In addition to the steps of research, design, and construct mentioned by Papert (1980, 1990), Skillen (2008) stated that both the design process and the end product need to be shared with others in order for a complete and most effective constructionist learning process because learners learn subject matter best if they are required to convey their learning to others. Baytak (2009) also emphasized the importance of sharing artifacts in the constructionist design process as sharing offers an opportunity to obtain feedback,

redesign the artifacts and reconstruct knowledge in a better way. Wu (2001) underlined the importance of sharing to make students' ideas concrete and establish a more personal connection with their designs.

Bruckman (1998) stated that "constructionism works best when it is situated in a supportive community context" (p. 52); and asking for, receiving, offering, and providing help are not simple information exchanges but social acts that take place in the context of network relationships. Pinkett (2000) suggested that a constructionist learning environment, where individuals have interaction with not only other learners but also with their physical and virtual artifacts as well, should be based on individual interest but should provide deeper understanding with the support of a community of learners. He added that a constructionist learning environment mainly aims to enhance individual cognitive development of learners by considering the positive effects of the surrounding community. Bruckman and Resnick (1995) found in their study, the MediaMOO Project, that "letting the users build a virtual world rather than merely interact with a pre-designed world gives them an opportunity for self expression, encourages diversity, and leads to a meaningful engagement of participants and enhanced sense of community" (p. 2).

Early Constructionist research focused on a year-long daily workshop-oriented learning intervention involving elementary students' creation of computational fraction games using the Logo programming language (Reynolds & Harel Caperton, 2011). In their study, Harel and Papert (1991) emphasized the effectiveness of workshop-based settings in which the learning process is made explicit; creating complex representational artifacts; affordance to students of significant time daily to pursue the completion of a final design artifact; frequent student reflection upon and social expression about their

work in progress, knowledge-sharing, collaboration, and peer teamwork in a community of practice; sharing and presentation of final work in the team and group context.

Reynolds and Harel Caperton (2011) reported that Harel and Papert's (1991) research found that students evidenced a range of outcomes including "development of technical programming and design skills; project-based learning skills such as prioritization and time management; teamwork expertise; meta-cognitive advances as evidenced through conversation and artifact analysis; content knowledge gains about the mathematical subject matter of students' created games; and observed affective changes related to motivation for learning, self regulation and self efficacy" (p. 270-271) and "follow-up research has supported, refined and advanced the early findings and research methods utilized (e.g., Kafai 1995; Bruckman & Resnick 1995; Kafai & Resnick 1996; Urrea 2001; Kafai & Ching 2004; Kafai 2006; Kafai et al. 2007; Klopfer 2008; Reynolds 2008)" (p. 271).

Constructionist research has mainly focused on learning in mathematics and science. Harel's work on the Instructional Software Design Project (ISDP), where elementary-school children designed math software about fractions to teach younger children, is one example of the use of constructionist theory to teach math (Harel & Papert, 1991); alternatively, Kafai and Ching (2001)'s work of software design using science concepts, emphasizing the relationship between science talk and design activities shows a practical use of the theory in science education. Constructionism has also been considered as an effective solution for gender issues in STEM fields. Kafai (2006) suggested that available studies about constructionism show that both boys and girls enjoy constructionist methods for learning. According to Papert (1991),

feminist scholars have argued that many women prefer working with more personal, less-detached knowledge and do so very successfully. If this is true, they should prefer the more concrete forms of knowledge favored by constructionism to the propositional forms of knowledge favored by instructionism. (p. 10)

Social Constructivism

In recent years, education has been considered as a social process instead of the knowledge transfer from an active source to a passive receiver. Hausfather (1996) stated that “People come to social interactions with different perspectives, different interpretations, different understandings of a concept or task. To develop, individuals must take active roles in sharing understandings” (p. 3). Richardson (1997) argued that “knowledge is constructed by a person in transaction with the environment; that is, both the individual and environment change as a result of this learning process” (p. 7).

Newman (1990) wrote:

People don't learn...in isolation. They learn by being members of a learning community. While we each construct an individual interpretation of a particular situation, our understanding is shaped by contact with other people's perceptions of what's gone on. Our interpretation will hold until we become aware of a discrepancy either through some direct personal experience or from something we've heard or read elsewhere and discuss it anew (p. 8).

The idea of social construction has its roots in John Dewey's *Pedagogic Creed* (Hirtle, 1996) that focuses on social interaction in learning process. Dewey (1897) stressed the relationship between the psychological and social sides of education and explained that “education cannot be regarded as a compromise between the two, or a superimposition of

one upon the other” (p. 20). Based on psychological and pedagogical assumptions highlighting the effectiveness of social processes on learning, different social learning theories have been employed in education. One of the first and most well-known educational theories emphasizing the role of social interactions in learning is called social constructivism theory.

Social constructivism is a theory first defined by Lev Vygotsky who believed that language, mental, and social development is supported and enhanced by others through social interactions (Mathis, 2011). Like all constructivist ideas, whatever their distinctive emphasis, social constructivism holds Piaget’s notion that learners actively construct their own knowledge. Lev Vygotsky took Piaget’s notion and added Dewey’s focus on social interactions on learning. Most basically, Vygotsky’s theory is grounded on the idea that learning occurs first socially, and only after, internally. Abdal-Haqq (1998) defined social constructivism as a theory of constructivism, which is based on the idea that an individual’s development results from social interactions in which the individual internalizes, shared cultural meaning. Oldfather and West (1999) described social constructivism as “a view of learning that provides a theoretical base for making decisions about pedagogy and curriculum” (p. 9). The idea of social constructivism holds that the understanding of the individuals is developed through the social communication of ideas (Vygotsky, 1978; 1986). Vygotsky (1978) stated that “Learning awakens a variety of development processes that are able to operate only when the child is interacting with people in his environment and in collaboration with his peers. Once these processes are internalized, they become part of the child’s independent developmental achievement” (p. 244). He also believed that learners progress through these development

stages through socially mediated situations (Vygotsky, 1986). Kim (2001) described social constructivism theory as a social process where meaningful learning occurs in case individuals are engaged in social activities. He warned that these social activities do not require external forces, but it necessitates two way interactions between learners and his/her social circle. Olson (2007) stated that social constructivism theory requires designing learning processes based on the ideas that students construct their own learning, subject matter connections are made, and social interactions are vital for learning. He also argues,

...social constructivism is not in and of itself a learning theory. Social constructivism describes a set of principles regarding the nature of knowledge and of learning and draws its specific detail from other established learning theories. It is important to note that social constructivism is not a methodological technique or teaching strategy. Rather, it informs such strategies as Problem-based Learning, Case-based Learning, and Active Learning (p. 42).

Hausfather (1996) characterized Vygotsky's theory into three themes: (1) the way to understand the mind is through how it changes and transforms, (2) all advanced mental functions in the mind originate socially, and (3) the tools and signs such as language mediate higher mental functions. On the other hand, Olson (2007) listed the three tenets of social constructivism as follows: "1) students must be active participants in developing their understanding; 2) social interaction is critical for learning to occur; and 3) students learn best when they actively create meaningful connections" (p. 44).

Social constructivist methods underpin current reforms in education. "At the school level, social constructivism implies a form of learning in which students are fully

engaged, find the process meaningful, and relate ideas to the real world to a considerable extent” (Beck & Kosnick, 2006, p. 2). Brophy (2006) underlined both the advantages and the disadvantages of the social constructivist methods. He argued that social constructivist approaches to teaching and learning requiring active discussions and co-construction of understanding within a collaborative learning community are more attractive than transmission approaches with direct lecture and passive listening. However, he also stated that there are some difficulties with social constructivist approaches such as onerous implementation, requiring both content and pedagogical knowledge, and a great deal of time to get students work as a learning community. For effective implementation of social constructivist methods in classrooms, Graham outlined seven principles: (1) Developing an activity framework, (2) Establishing an accountability system, (3) Developing monitoring procedures, (4) Setting up a common experience, (5) Ensuring frequent repetition, (6) Repeating critical content, and (7) Training students in group interaction procedures (Brophy, 2006, p. 533).

One of the most important aspects of social constructivism is “Zone of Proximal Development”. Hausfather (1996) believed every learner has both an actual developmental level and potential developmental level within the domain. The range between these two levels indicates the Zone of Proximal Development (ZPD) (see Figure 2.1). Pritchard and Woollard (2010) described ZPD as follows

Vygotsky’s notion of the ZPD is a crucial percept, which is central to all of social constructivist learning theory. The ZPD describes the difference between what a person can learn on his or her own and what that person can learn when learning is supported by a more knowledgeable other. Appropriate and timely

interventions in the course of learning within an individual's ZPD has become an essential strategy for teachers working with the social constructivist approach. (p. 9)

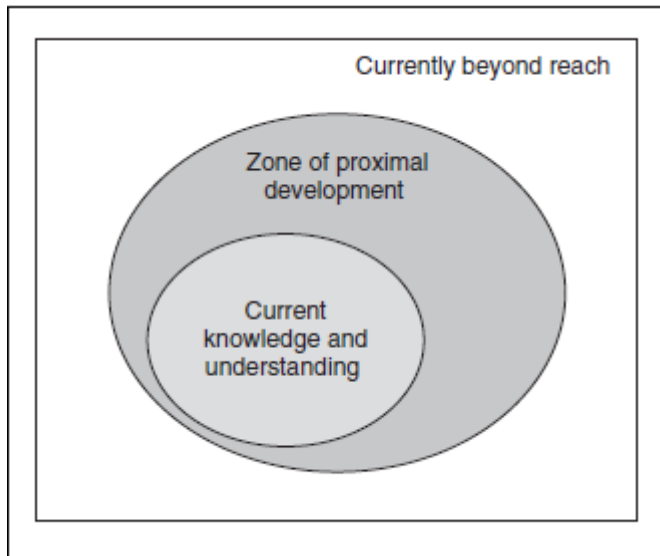


Figure 2.1. Zone of Proximal Development (Pritchard & Woollard, 2010)

According to Olson (2007), ZPD is “a psychological construct describing the individual’s performance on a given measure without assistance, and his or her performance with assistance of a more knowledgeable individual” (p. 47). Vygotsky (1978) considered ZPD as “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (p. 86).

Social Networks in Education

Media has a strong influence on the social, emotional, and cognitive development of today’s generation of youth, accounting for a large portion of their time (Roberts, Foehr, & Rideout, 2005). Roberts et al.’s (2005) study indicated that 8-18 year old U.S.

youth spend approximately 6.5 hour per day with media. Recently, social networks have become an important part of the media technologies due to the developments in computer and internet technologies. There has been “tremendous growth in the popularity of websites focusing on social activities and collaboration” (Abbitt, 2007, p. 1). The concept of internet-facilitated social networking is not new, but the emergence of social networking sites has expanded accessibility and use beyond levels in recent years (Lockyer & Patterson, 2008). Since social networks provide direct interaction among users/participants of the environment, they are considered innovative and different from traditional media such as television, film, and radio (Pempek, Yermolayeva, & Calvert, 2009). “Social network communities (SNCs) have increased in popularity over the past five years functioning as personal and personalizable spaces for online conversations and sharing of content” (Selwyn, 2007, p. 3).

Gunawardena et al. (2009) defined social networking as “the practice of expanding knowledge by making connections with individuals of similar interests” (p. 5). They added that social networking technologies are “tools facilitating collective intelligence through social negotiation when participants are engaged in a common goal or a shared practice” (p. 6). One of the most widely accepted definitions of social networks is provided by PC magazine as follows:

A web site that provides a virtual community for people interested in a particular subject or just to "hang out" together... Members create their own online "profile" with biographical data, pictures, likes, dislikes and any other information they choose to post. They communicate with each other by voice, chat, instant

message, videoconference and blogs, and the service typically provides a way for members to contact friends of other members.

(http://www.pcmag.com/encyclopedia_term/0,2542,t=social+networking+site&i=55316,00.asp)

Boyd and Ellison (2007) also joined the efforts to find a definition for social networks.

They defined social networking sites as:

web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connections, and (3) view and traverse their list of connections and those made by others within the system. The nature and nomenclature of these connections may vary from site to site (p. 211).

Social networking sites are designed in order to promote social interaction among the members in a virtual online environment. Pempek, Yermolayeva, and Calvert (2009) stated that communication is facilitated through information posted in the profile which provides information about one's identity, and it is provided through various applications similar to email or online message boards.

Social networks have become very important part of younger generations' life. A nationally representative survey results indicate that 41% of 12-13 year olds and 61% of 14-17 year olds use social networking sites in the US (Lenhart & Madden, 2007).

Additionally, about half of 12-17 year olds with social networking site membership log on daily: 22% logged on to social networking sites several times per day, 26% once a day, 17% three to five days per week, 15% one or two days per week, and only 20% every few weeks or less. Another recent survey shows that 48% of young Americans say

they find out about news through Facebook, one of the most popular and widely used social media worldwide (<http://www.onlineschools.org/blog/facebook-obsession/>).

There have been strong efforts to integrate different kinds of technologies such as software and online technologies to promote instruction and student learning. As Sefton-Green (2005) concluded from an extensive review of literature in the area:

Computers and other aspects of Information and Communication Technologies (ICTs) allow children and young people a wide variety of activities and experiences that can support learning, yet many of these transactions do not take place in traditional educational settings. In fact many of these may not be considered 'educational' according to our conventional understanding of that term (p.3).

Social networking websites are one such technology of interest to education researchers. Tynes (2007) listed the psychosocial benefits of social networks as the facilitation of identity exploration, provision of social cognitive skills, and fulfillment the need for social support, intimacy and autonomy. Gunawardena et al. (2009) explained the role of social networks in the learning process as follows: "The paradigms for learning have already evolved beyond traditional classroom models to synchronous & asynchronous, interactive, and collaborative learning, which is further extended by Web 2.0 tools and social networking approaches" (p. 3). The authors believe that the type of learning that Web 2.0 and social networking technologies facilitate provides an opportunity to improve existing learning theories primarily because the theories were developed when wide ranging online communication between people of different races, locations, and viewpoints was not possible. Conole and Culver (2009) argued that effective application

of social networks in education can provide a means of addressing the lack of uptake and sharing of learning and teaching ideas and designs. The various networks and social structure established within social networks can help promote additional student-student and educator-student interaction (Griffith & Liyanage, 2008). Gunawardena, Lowe, and Anderson (1997) put forward a model for phases of learning that fits into social networking processes. The model was comprised of five phases: (1) Sharing/Comparing, (2) Dissonance, (3) Negotiation/Co-construction, (4) Testing Tentative Constructions, and (5) Statement/Application of Newly-Constructed Knowledge. The model is mostly used to analyze the discourse and social interaction occurring among learners in an online environment (Lockyer & Patterson, 2008).

Dalsgaard (2008) argued that developing social networks provides a pedagogical potential that supports transparency. He emphasizes the importance of transparency which means that “students are visible to each other as potential partners and resources” (p. 5). To provide transparency, the social network has to provide both personalization and socialization. Personalization is presented by a personal profile page that provides the personal representation of individual’s on social networking site. In addition, research conducted by Mazer, Murphy, and Simonds (2007) revealed that the more personalized social networks presence the greater motivation of students to participate and learn course material. On the other hand, “socialization begins when a personal page is connected to other personal pages of other individuals. Each individual builds his/her own network of personal relations” (Dalsgaard, 2008, p. 4). Selwyn (2007) reported sharing ideas, providing peer feedback, and engaging in critical thinking are the types of interaction that has taken place in social networking sites in terms of socialization. Social networking

sites have shown that students are willing to invest time and effort in building relationships around shared interests and knowledge communities (Maloney, 2007). This creates a strong argument to integrate the social networks into the education to promote socialization among the participants of the learning environment.

Social and Environmental Awareness and Activism

Awareness is an extremely broad term that may be interpreted to mean realization of issues or, alternatively, amenities (Fisman, 2005). There are two theoretical lines of research for explaining awareness. The first defines awareness as conceptual knowledge, whereas the second relates awareness to the perception of actions and system components, involving intentions and values (Pata & Zimdin, 2008).

Although social awareness and environmental awareness refer to different constructs, science and environmental educators often use these terms interchangeably. Social awareness is a term employed by many researchers in not only education but also other fields of study. Cismas, Vajjala, and Andreiasu (2011) defined the term social awareness as follows: “Social awareness is awareness of the social situation in a group or community in a shared environment, which can be physical, virtual or both: people’s roles, activities, positions, status, responsibilities, social connections and group processes. Social awareness encompasses awareness of social situation in general and social situation at a certain moment” (p. 1). According to Prasolova-Forland (2002), there exist a number of different definitions of social awareness in the literature. Some researchers defined social awareness as awareness about the social situation of other people whereas other researchers defined awareness related to the social connections within a group. Based on these two groups of definitions, she concluded that “Social awareness is

awareness of the social situation in a group or community in a shared environment, which can be physical, virtual or both: people's roles, activities, positions, status, responsibilities, social connections and group processes" (p. 1).

On the other hand, environmental awareness is "the growth and development of awareness, understanding, and consciousness toward the biophysical environment and its problems including human interactions and effects -in other words- thinking "ecologically" or in terms of an ecological consciousness" (North, 1997, p. 178). Pata and Metsalu (2008) described two philosophical positions for environmental awareness. The first position considers environmental awareness as conceptual knowledge, while the second position considers environmental awareness as closely connected to the actions and system components, where intentions and values also play an important role. Tanner (1999) defined two kinds of awareness related to environmental behavior. The first being personal or self awareness which reflects negative stressful feelings and awareness about environmental problems that threaten personal health and well-being, and the second being general awareness that focuses on the potential harmful outcomes for society and nature. Pederson (1999) suggested that environmental awareness usually results in certain nature-protective behaviors, and lack of awareness would indicate lack of knowledge of environmental problems, or/and lack of motivation to act in favor of environmental values.

Although personal (or self) awareness, social awareness and environmental awareness are the terms sometimes used interchangeably in an environmental education context, Littledyke (2008) distinguished these three different kinds of awareness. He believed that personal awareness is about how one's actions impact the environment;

social awareness is how people interact socially to influence individual choices; finally environmental awareness is how society impacts ecosystems through political choices. He also believed that reason and emotions can be integrated with socially or ecologically beneficial behavior at the individual, societal and political levels in this way. Considering the social and environmental aspects of environmental problems, particularly climate change and global warming, both social and environmental awareness were considered as one of the goals of this study.

Awareness and activism in environmental education. The world's environmental problems including climate change, global warming, pollution, etc. are problematic, controversial, complex and interrelated, and usually result from human effects. Thus it is critical to educate students on environmental issues to improve their awareness about environmental and motivation to act in favor of environment. Cetin and Nisanci (2010) argued that students at all levels should be educated about the environment to raise environmentally aware individuals who take responsibility and action to overcome environmental problems. "Issues related to environmental problems have become a major concern also for the international community, particularly for educational policy makers and curriculum developers" (Mutisya and Barker, 2011, p. 55). In recent years, environmental problems such as climate change and global warming has become the main focus of not only educators and researchers but also international organizations whose goal is to improve the awareness of others on environmental issues (Baytak, 2011).

The goals of increasing social awareness and activism are evident in all descriptions of environmental education. According to the Belgrade Charter announced

by UNESCO and UNEP with representative from 60 countries in former Yugoslavia in 1972, the goal of environmental education was described as "to develop a world population that is aware of and concerned about the environment, its associated problems, so that the population will have the knowledge, skills, attitudes, motivation and commitment to work individually and collectively towards the solutions of current problems and prevention of new ones" (p. 94). At an international conference sponsored by UNESCO in 1977, the Tbilisi Declaration (UNESCO, 1977) set one of the most widely accepted definitions of environmental education. In that declaration, environmental education was defined as "a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action" (UNESCO, 1978). This document described knowledge, awareness, and taking positive actions as necessary precursors to environmental stewardship. Fisman (2005) emphasized the role of environmental education being to help students to become responsible citizens of the future by providing both the environmental content and the ability of applying this content to solve environmental issues.

Coertjens, Boeve-de Pauw, De Maeyer, and Van Petegem (2010) indicated that "the environmental agenda is gaining momentum as an international policy issue. This is reflected in an increase in environmental education research focusing on children's awareness and attitudes toward the environment" (p. 497). According to Stapp et al. (1969), the main goal of environmental education has been "to produce citizens who are knowledgeable about the biophysical environment and its problems, aware of strategies

that can be used to deal with those problems, and actively engaged in working toward their solution” (as cited in Fisman, 2005, p.39); however, current environmental education practices may not be the most effective pedagogical approach to create environmental concern (Fisman, 2005) and positive actions. Jensen (2002) reported that the cognitive factors influencing positive environmental behaviors are awareness of the problem, environmental knowledge, and constructed knowledge centered on action. Educational programs developed within a K-12 context have focused on increasing environmental knowledge in learners (Hungerford & Volk, 1990; Rusell, 1999; Spork, 1992) guided by an assumption that a linear relationship exists between environmental knowledge and behavior (Caldarelli, 2004).

According to Mutisya and Barker (2011), one of the most challenging objectives of environmental education is to make people aware of their environment and able to take actions to protect their environment for future generations. In addition to informing learners about the environmental issues, letting them how to take actions in favor of protecting the environment is one of the main goals of the environmental education. In their study, Mutisya and Barker (2011) found that although the primary school students in their study were aware of key environmental issues in their local areas, a majority of them were not aware of that human actions were the causes of these environmental issues, and affect the environment and natural life negatively.

According to Hungerford, Ben Peyton, and Wilke (1980), the most commonly stated overall and ultimate goal of environmental education is “to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or

maintaining a dynamic equilibrium between quality of life and quality of the environment” (p. 42). This goal is stated in different ways by many authors and organizations. The National Environmental Education Advisory Council (NEEAC) proposes the place of awareness and taking action in environmental education by stating, “Environmental education enhances lifelong learning skills, including critical thinking, problem solving, collaboration, and decision making” (NEEAC, 2005, p.10). The majority of approaches in environmental education focus on conveying knowledge, problem solving, and raising environmental awareness (Hungerford & Volk, 1990; Pomerantz, 1991; Russell, 1999; Spork, 1992).

Hungerford (1985) distinguished the levels of environmental education instruction whose primary aim is the development and demonstration of environmentally responsible behavior as follows: ecological concepts, conceptual awareness, issue investigation and evaluation, and environmental action skills. Jenkins (2009) claimed that environmental education needs to actively engage students in learning about environmental and sustainability issues, which requires a sufficient environmental awareness. Similarly, Altin, Bacanli, and Yildiz (2002) stated the major goal of environmental education is to increase individuals’ environmental awareness and sensitivity, which can improve one’s standard of living by fostering a healthier and safer environment. Huckle (1991) believed that in addition to the desired change of understanding, appreciation, and concern for the environment, the development of environmental responsibility and active participation in resolving environmental issues are expected as the goal of environmental education. Chandler and Swartzentruber (2011) explicitly stated the importance of awareness and action for environmental education by stating “Environmental education facilitates the

production of students with an awareness of the natural world and a motivation to take responsibility for the upkeep of their world” (p. 11).

There are three approaches to environmental education: education about the environment, education in the environment, and education for the environment (Tillbury, 1995). In the *education about the environment* approach, the main concern is to understand human-environment relationship and to develop environmental knowledge and awareness. Through this approach, “pupils primarily develop ecological or environmental understanding, although at times environmental concern may also result” (p. 195). *Education in the environment* focuses on outdoor experiential activities that put the learner at the center. This approach mainly aims to develop environmental awareness and concern through direct contact with nature. “Whilst the above approaches limit themselves to promoting understanding, appreciation and concern, education for the environment goes beyond this to develop a sense of responsibility and active pupil participation in the resolution of environmental problems” (Tillbury, 1995, p. 195). Finally, *education for the environment* addresses both social awareness and activism for environment. Caldarelli (2004) stated that although education for the environment most closely addresses the stated goals of environmental education, the in and about approaches tend to dominate the field of informal and K-12 environmental programs.

Awareness and activism in scientific literacy. Throughout science education history, educating scientifically literate citizens has always been a primary goal. Sadler, Chambers, and Zeidler (2004) considered scientific literacy as the ultimate goal of science education, and that students should be able to negotiate socio-scientific issues to be considered scientifically literate citizens. Professional associations in science

education in the 21th century emphasize the importance of broadly conceptualizing scientific literacy including the ability to analyze, synthesize, and evaluate information; informed decision making; dealing with moral reasoning and ethical issues; and understanding connections inherent among socio-scientific issues (Zeidler, 2001). “It is clear from recent international research in science education that current reform initiatives in our field demand increased emphasis on the nature of science (NOS) and scientific inquiry, as well as development of broad conceptual frameworks encompassing progressive visions of scientific literacy that entail a commitment to the moral and ethical dimensions of science education—including the social and character development of children” (Zeidler & Keefer, 2003; as cited in Zeidler, Sadler, Simmons, and Howes, 2004, p. 358).

According to Bybee (1985), scientific literacy is not only related to content, but it is a concept consisting of scientific abilities, attitudes, and values. There are many different sources that underline the importance of educating socially aware and active citizens in the description of scientific literacy. The emphasis of social and environmental awareness and activism in different descriptions of scientific literacy proposed by researchers and organizations in science education field is apparent. For example, Millar and Osborne (1998) underlined the importance of scientific literacy as,

Our view is that the primary and explicit aim of the 5–16 science curriculum should be to provide a course which can enhance ‘scientific literacy’, as this is necessary for all young people growing up in our society, whatever their career aspirations or aptitudes . . . school science education should aim to produce a populace who are comfortable, competent and confident with scientific and

technical matters and artefacts. The science curriculum should provide sufficient scientific knowledge and understanding to enable students to read simple newspaper articles about science, and to follow TV programmes on new advances in science with interest. Such an education should enable them to express an opinion on important social and ethical issues with which they will increasingly be confronted. It will also form a viable basis, should the need arise, for retraining in work related to science or technology in their later careers (p. 9).

In 1989, Science for All Americans (AAAS, 1989) joined the efforts to describe scientific literacy. This document describes scientifically literate person as “one who is aware that science, mathematics, and technology are interdependent human enterprises with strengths and limitations; understands key concepts and principles of science; is familiar with the natural world and recognizes both its diversity and unity; and uses scientific knowledge and scientific ways of thinking for individual and social purposes” (p. 4). In 1993, AAAS offered a new description of scientifically literate persons. In this description, they stated that scientifically literate person is the one who is able to use the knowledge of science, mathematics, and technology to understand the real world experiences (AAAS, 1993). In addition, they cast a new role to science by stating that science can provide solutions to both local and global problems and an intelligent respect for nature via informed decisions. Although these two descriptions involve some intention to relate scientific knowledge and social aspects, Hodson (2003) criticized these descriptions because they only weakly and implicitly describe the necessity of awareness and activism. He stated,

The authors of *Science For All Americans* (AAAS, 1989, p.12) direct attention towards scientific literacy for a more socially compassionate and environmentally responsible democracy when they state that science can provide knowledge ‘to develop effective solutions to its global and local problems’ and can foster ‘the kind of intelligent respect for nature that should inform decisions on the uses of technology’ and without which, they say, ‘we are in danger of recklessly destroying our life-support system’. Regrettably, they don’t go on to suggest that scientific literacy also includes the capacity and willingness to act in environmentally responsible and socially just ways (p. 652).

Similar aspects can be found in other definitions of scientific literacy in the documents and reports prepared by international organizations. The Organization for Economic Cooperation and Development’s (OECD) Programme (1998) for International Student Achievement (PISA) proposed that a scientifically literate person is “able to combine science knowledge with the ability to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity” (p. 5). In the 2006 report of OECD Programme for PISA, environmental attitudes were incorporated into the definition of scientific literacy. The main characteristic of a scientifically literate person across these documents is using scientific knowledge in real world in terms of individual and social purposes.

According to Roth (1992), environmental literacy that aims to develop environmentally aware and responsible citizens should be the main goal of environmental education. Environmental literacy is “the capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore, or

improve the health of these systems” (Roth, 1992, p. 8). He distinguishes four stages of environmental literacy: awareness; concern; understanding; and action. In this four stage approach, he describes awareness as the sensitivity of human and nature relationship that can be both emotional and/or cognitive, whereas action is the application of any understanding that results individual and corporate behavioral changes in favor of reducing or stopping negative consequences on nature.

Although there is not enough research to have a strong conclusion about the correlation between scientific literacy and environmental awareness and activism, both Lester et al. (2006) and Coertjens, Pauw, De Maeyer, and Van Petegem (2010) found that students’ science literacy and environmental awareness and attitudes are positively associated.

Awareness and activism in science technology and society movement. “The role of the citizen in a society is to be involved in resolving controversies and societal issues created by the changing relationships between science, technology, and society” (Patronis, Potari, & Spiliotopoulou, 1999, p. 752). The Science Technology and Society (STS) movement is considered as a curriculum approach that aims to make the traditional science and social studies instruction more appropriate and relevant to the lives of both the students and the society (Hurd, 1998; Ziman, 1980). STS is usually referred to as an instructional approach including appropriate STS knowledge, skills, attitudes, and values. Operational STS instruction “engages students in the development of decision-making skills and attitudes and encourages them to make informed judgments about science and technology issues” (Heath, 1992, p. 52). Lester et al. (2006) stated that “While promoting students’ scientific knowledge, STS instruction challenges students to apply their

knowledge in a socially responsible manner (e.g., turn the lights off when they are not in use, buy energy efficient products, think about fuel efficiency)” (p. 317).

Mansour (2007) stated that the STS movement strongly supported the idea that students as the citizens of the future should understand the interaction of science, technology and society to be able to make critical decisions. In support of the STS movement, both Pedretti (1997) and Solomon (1994) stated that science and technology cannot be separated from their social purposes and responsibilities.

In response to the urgent needs of the society, science education should pay more attention to the STS movement and each aspects of STS (Eijkelhof & Lijnse, 1988). Yager (1992) explained the ultimate goal of the STS movement and its connection with educating students, the citizens of the future, as follows:

Basic to STS efforts is the production of an informed citizenry capable of making crucial decisions about current problems and issues and taking personal actions as a result of these decisions. STS means focusing upon current issues and attempts at their resolution as the best way of preparing students for current and future citizenship roles (Yager, 1992, p. 3).

Bingle and Gaskell (1994) also highlighted the role of STS movement in science education:

STS education takes place in the context of concern about citizens being able to make defensible decisions in a highly complex world where it is often difficult to distinguish in the news media between outrageous and fanciful claims on the one hand and stable and respected claims on the other. Important policy documents

(AAAS, 1989; NSTA, 1982) promoting an STS approach to science education try to address this problem (p. 196).

STS education is premised on the belief that “science education should include historical, philosophical, cultural, sociological, political, and ethical perspectives” (Pedretti, 1999, p. 174) and the citizens of the future should be able to make defensible decisions in complex situations (Bingle & Gaskell, 1994). In STS education, the goal of the curricula is to engage students in social dimensions of science (Ziedler, Sadler, Simmons, & Howes, 2004). The STS movement aims to enhance students’ understanding of science through real world experiences and application of their understanding in social situations (Aikenhead, 1994; Bybee, 1991, 1993; Cross & Price, 1999; Hurd, 1997, 1998; Waks, 1992; Yager & Roy, 1993).

Lester et al. (2006) stated that integrating social activism in science curricula is most often conceptualized in the STS movement and “the discussions of STS interactions help students develop insight into their own values and participate as citizens” (p. 317). The results of their study indicate that more students expressed activism more frequently and more appropriately at the completion of the STS based instruction with regard to the particular societal problem of focus.

Conclusion

In this chapter, the literature related to this study was reviewed. Constructionism, social constructivism, social networks in education, and environmental awareness and activism were investigated. The following chapter will describe the research design and methods employed in this study. In addition, data collection and analysis procedures will be discussed.

Chapter III: Research Methods

Research Design

This study employed the convergent parallel design of mixed methods to investigate the learning processes used by high school students to design media projects showing the development of their social/environmental awareness and activism within the context of the climate change unit, using the theoretical frameworks of constructionism and social constructivism. The convergent design of mixed method was chosen to combine the powerful ways of qualitative and quantitative methods of inquiry and to compensate for the weaknesses of these methods in isolation (Patton, 1990). As Creswell and Plano Clark (2011) suggested, convergent design was used to triangulate the methods by directly comparing and contrasting quantitative statistical results with qualitative findings for corroboration and validation purposes. Creswell and Plano Clark (2011) stated that

The convergent parallel design (also referred to as the convergent design) occurs when the researcher uses concurrent timing to implement the quantitative and qualitative strands during the same phase of the research process, prioritizes the methods equally, and keeps the strands independent during analysis and then mixes the results during the overall interpretation (p. 70-71) as shown figure 3.1.

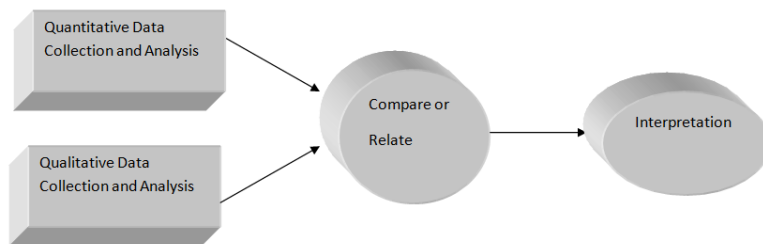


Figure 3.1. The convergent parallel design process

Both forms of data are collected and maintained separately during the study, and then integrated in the interpretation of the final results (Creswell, 2003). By employing mixed methods, this study provided intensive and reliable results about how the instructional intervention and media designing process affect students' awareness and activism in the context of Climate Change. Specifically, the following research questions were addressed:

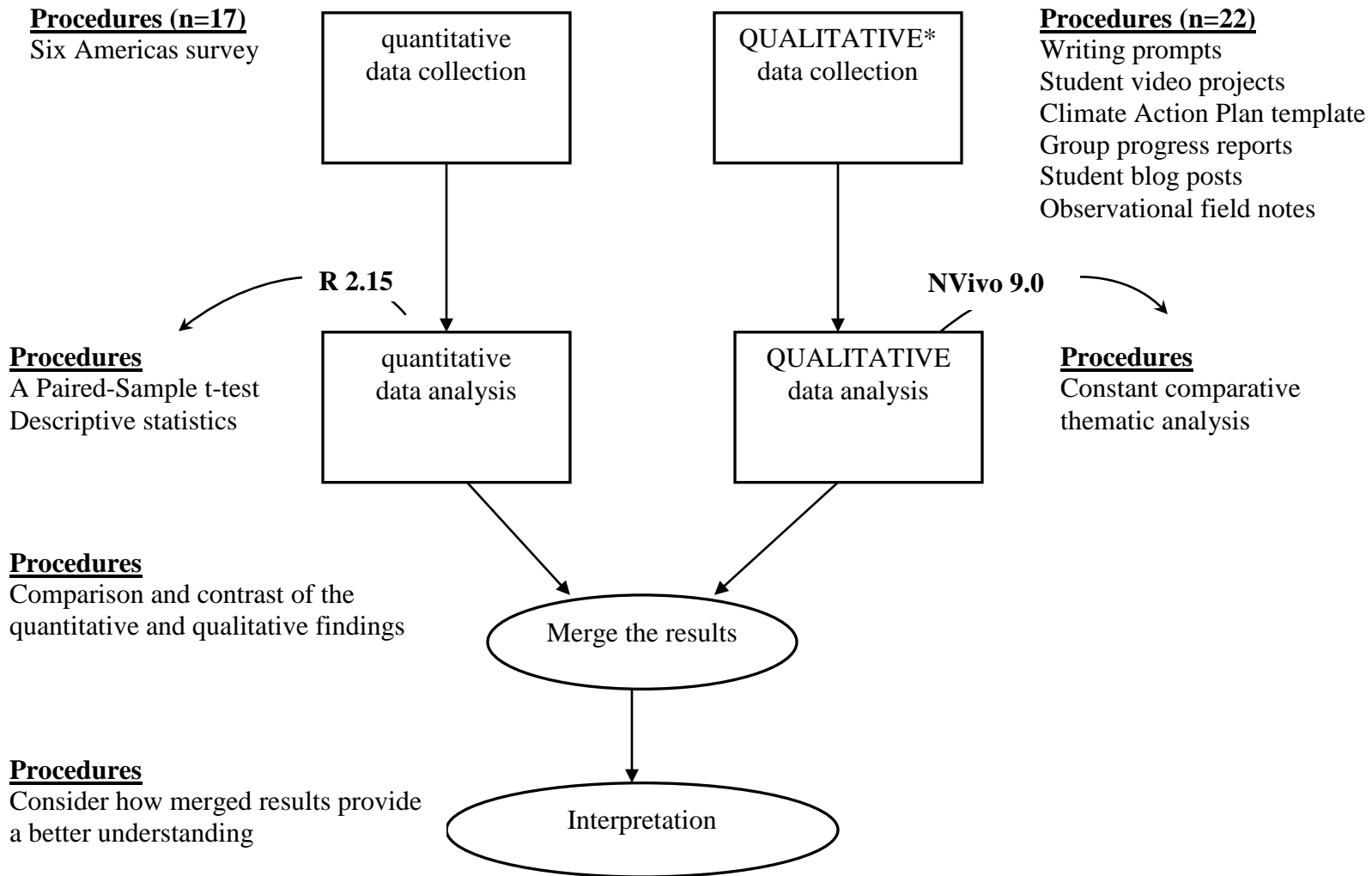
1. How do constructionist and social constructivist frameworks impact students' environmental awareness?
2. How do constructionist and social constructivist frameworks impact students' environmental activism?
3. How do students express environmental awareness and activism throughout constructionist and social constructivist learning processes?
4. How do constructionist and social constructivist frameworks affect students' motivation and engagement?

Data Collection

Using a mixed method approach, data was collected to provide a better understanding of the change in students' social/environmental awareness and activism. Seven main types of data were collected: Six Americas survey; student video projects; writing prompts; blog entries; video projects of the students; observational field notes; and reflective journals (see Figure 3.2).

The research design encompassed approximately nine focused weeks of data collection with the corresponding environmental science curriculum and implementation couched within that time span. Research commenced during the first week of February

2012 and concluded at the end of the third quarter in mid-April 2012. Of the nine total weeks of research, I was physically in the classroom both as the instructor and researcher.



* Uppercase letters indicate that qualitative data sources used as the primary data sources while quantitative data source used as the secondary data source.

Figure 3.2. Diagram of the convergent design used for this study

Research Site and Participants

The research site of this study was a high school located in an urban area in the Midwest. The school offers a secondary educational program to teenagers who are pregnant and/or parenting. The educational program includes courses in Social Studies, Mathematics, English, Family and Consumer Sciences, Career Investigations, Science, Physical Education, and On-The-Job Training. In addition to these courses, the program provides intervention services to help students address other barriers to educational success. Those services include social, emotional, and physical health services or referrals, English Language Learner and Special Education Support. Students attending this school are usually teenagers from lower and middle class socio economic backgrounds. The free and reduced lunch rate was 100%.

Twenty two 10th to 12th graders between the ages of 16 and 19 were recruited from their environmental science class to participate in this study. There were two 10th grade, eight 11th grade, and twelve 12th grade students in the classroom. The class included 8 English Language Learner (ELL) students in different levels. In addition, there were one homeless, two special education, three gifted and talented, and one home bound students in the class.

Class Setting

The study was conducted in a science classroom in a laboratory setting. The classroom was organized based on cooperative learning techniques. The five lab tables gave students the chance to work with their base groups during the entire quarter. In addition, the classroom was structured loosely in a setting that encouraged students to move around and share knowledge and strategies informally. The classroom was

comprised of a variety of technology including two smart boards, one projector, five desktop computers for general use, twenty laptops, one electronic overhead projector, and speakers. All these technologies were accessible for students' use.

During class time, each student has access to a computer with a server personal account access through the internet. In addition, USB drives were provided to each student to store their electronic project materials. Extra computers were available in case of any technical problem with the assigned computers. Media sharing and social network websites restricted by the school district were made accessible during this particular class period.

During class time, the researcher and the science teacher were physically present in the classroom. The science teacher was responsible for classroom management, whereas the researcher took the responsibility for teaching the science content and assisting the students during their design process.

Theoretical Framework

Environmental problems are socially constructed in terms of their conceptualized effects on individuals, groups, other living things and systems, [and accordingly,] research based on constructivist principles provides not only a coherent framework in which to theorize about learning, but also a context for understanding socially constructed issues and knowledge” (Palmer & Suggate, 2004, p. 208). This study employed two constructivist frameworks which are constructionism and social constructivism to enhance students' environmental awareness and activism. Vygotsky (1978) described social constructivism in two steps. First, learning awakens a variety of development processes that are able to operate only when the child is interacting with

people in his environment and in collaboration with his peers. Then, these processes are internalized, they become part of the child's independent developmental achievement (Vygotsky, 1978, p. 244). On the other hand, Papert (1991) stated that constructionism involves two stages, internal and external. The internal stage is an active process where students construct their knowledge from their experiences in the world. The external stage is based on the idea that student learning is most effective when they design artifacts and share with others. Considering the constructivist base of these two theories, the three step framework of this study was created (see Figure 3.5). The instructional and research processes were implemented based on this framework

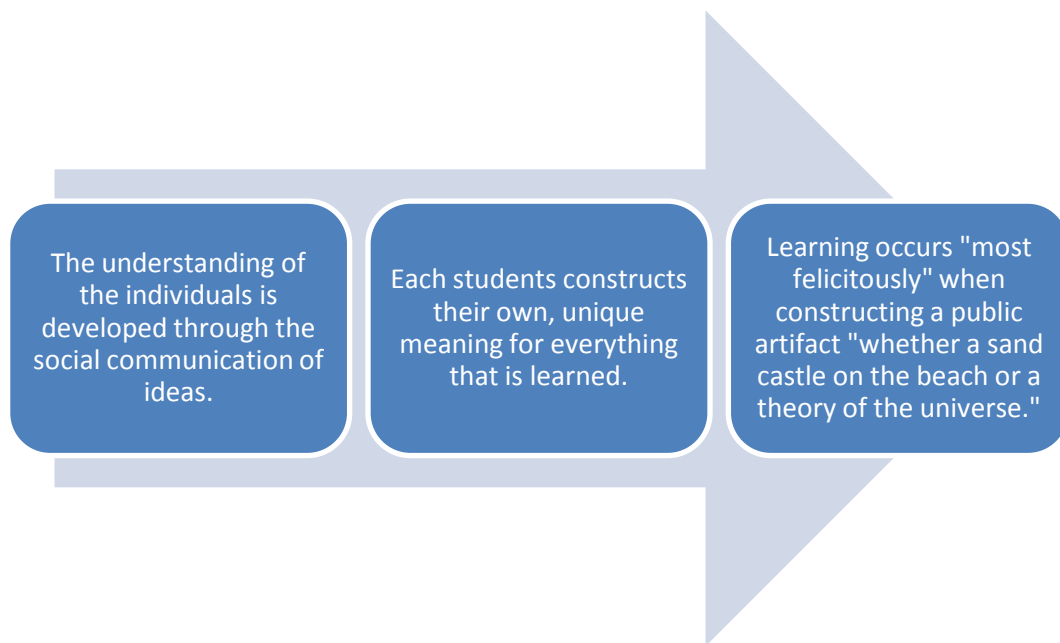


Figure 3.3. The framework of the study

Instructional Intervention

During the research process, three instructional steps were followed based on the research goals, therefore guided the instructional intervention. Considering the dynamic relationship between environmental awareness and activism, students first introduced to

the activities that addressed their environmental awareness, and then they participated in a designing process that enhanced their environmental activism. These steps were assigned as (1) environmental awareness, (2) expressing environmental activism, and (3) environmental activism in this order (see Figure 3.4).

This study is grounded on two bodies of instructional approach, including: (a) in-class instruction and classroom activities; and (b) online learning environment.

In-class instruction. To promote social/environmental awareness and activism in regards to environmental issues, the instruction during the quarter was enhanced with both constructionist and social constructivist activities. These activities involved small group and whole class discussions instead of teacher centered instruction. The materials used in the classroom were mainly chosen from real world media such as short documentaries, newspaper articles, news reports, and the videos and posters designed by environmental activist groups etc. After using each kind of media as an instructional tool, students first joined small group discussions and then, whole class discussions. Table 3.1 shows the instructional plan implemented through the quarter:

Table 3.1. The instructional plan

| Goals | Date | Main Instructional Theme | Activity |
|------------------|---------------------------|--------------------------------|---|
| Social Awareness | Week 1 (February 9-10) | Being a Community | <ul style="list-style-type: none"> ➤ Organizing base groups ➤ Introducing social networking website |
| | Week 2 (February 16- | Realizing the causes, effects, | ➤ Building connections |

| | | | |
|--|---------------------------------------|-------------------------------------|---|
| | 17) | and ways to prevent Climate Change | between the causes, effects and ways to stop Climate Change |
| | Week 3 (February 23-24) | From local to global | ➤ Realizing the current effects of Climate Change on different parts of the world |
| | Week 4 (March 1-2) | Making a difference and action plan | ➤ Climate Action Plan |
| | Week 5 to 9 (March 8 through April 6) | Time to take action | ➤ Designing artifacts ➤ Theory into action |

For more effective in-class instruction, cooperative learning methods were employed to promote learning. According to Johnson, Johnson, and Johnson Holubec (2008), “cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other’s learning” (p. 1:5). They believe that to make cooperative learning methods work, there has to be four elements which are positive interdependence, individual accountability, face-to-face promotive interaction, interpersonal and small group skills, and group processing.

During the first week, students were organized in their base groups. Small activities were implemented to both introduce the content and to make students get accustomed to cooperative group work. Students also familiarized to the social

networking website by figuring out how to use it throughout the quarter. They learned some basic skills related to use of social networks such as organizing profiles, sharing media and interacting others. In the second week, the focus of the instruction was an overview of the causes and effects of the environmental problems, and the ways to mitigate these problems. Students researched about environmental problems, particularly climate change, during the week, and share their findings with their group mates first, and then the class. The third week gave students a chance to broaden their view about environmental problems. They focused on the environmental problems experienced by different parts of the world. They shared their materials related to the global perspective of environmental issues through their profiles on the social network. During the fourth week, students worked on the Climate Action Plans. In this week, they transferred their knowledge they had obtained into the action. Week five to nine were dedicated to the constructionist media designing processes. The activities between week five and week nine were gathered around the designing purposes.

Constructionist media design process. In addition to the instructional process, students worked on their video design project within the following specified steps for five weeks (see Table 3.2). Students were expected to reflect their environmental awareness and activism that they obtained during the quarter in these video projects. Grounded in the theoretical framework of constructionism, four main phases of constructionist design process were implemented in this study (Harel, 1991; Kafai, 2005): planning, designing, testing, and sharing (see Figure 3.6).

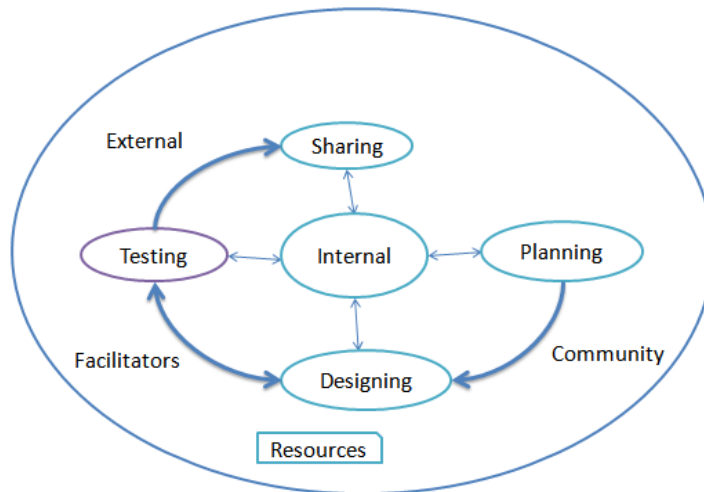


Figure 3.6. A common activity and interaction process in a Constructionist Learning Environment (Baytak, 2009).

The planning phase occurred during the first week of the design process. After creating project groups, students completed brainstorming activities where they made initial decisions and plan the actions taken in the following weeks. During the planning process, web resources and the researcher support were available.

During the two-week designing step, the students designed their media projects. In the first week of the designing process, they collected videos, photos, and information from the web to use in their video projects. Next, students used digital cameras to record videos and took pictures. After collecting their digital materials, the group members came together and decided which materials they wanted to include in their video projects. The students created their videos using a user-friendly video design software called Animoto. Although the students mainly focused on their plans, they also had a chance to explore new information pursuing new ideas about their video project during this phase.

The third step, testing, is more appropriate for constructionist game design processes (as described in chapter II), however, there were some benefits to using the

testing step for this particular media design process. During this phase, students checked their designs to insure that all of the requirements were included in their media designs. Students were provided the list of requirements involving content, design, cooperative work, and presentation. The content part indicated that students need to reflect their learning about environmental problems and related content via their video projects. Design part required students to use different kinds of materials in their video projects such as written texts, images, videos, and music. Cooperative work addressed whether students' worked cooperatively by sharing responsibilities to promote each others' learning during the designing process. Lastly, presentation part required students to present their video projects and their designing efforts at the end of the constructionist learning process. If they missed any of the criteria, they had a chance to modify their videos by adding or re-organizing video elements.

The final phase was sharing. After completing the video projects, students presented their projects in the classroom. While presenting their videos, group members shared both their researching and designing processes with their classmates. Then, they presented their projects for an audience including the school community.

Table 3.2. Timeline of the media design plan

| Time period | Constructionist design phase | Actions |
|------------------------------------|-------------------------------------|--|
| Week 3 (February 23-24) | Planning | <ul style="list-style-type: none"> ➤ Brainstorming ideas ➤ Reporting ➤ Sharing ideas with other group |
| Week 4-5 (March 1-2 and March 8-9) | Designing | <ul style="list-style-type: none"> ➤ Collecting materials from web |

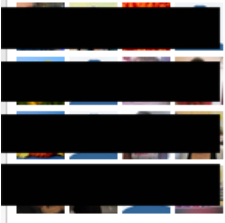
| | | |
|----------------------|---------|---|
| | | <ul style="list-style-type: none"> ➤ Recording videos, taking photos ➤ Organizing materials ➤ Designing the video projects |
| Week 6 (March 22-23) | Testing | <ul style="list-style-type: none"> ➤ Testing the last drafts of video projects ➤ Making improvements and corrections |
| Week 7 (March 29-30) | Sharing | <ul style="list-style-type: none"> ➤ Presenting video projects with classmates and school community |

Online learning environment. In addition to the physical classroom environment, an online learning environment designed by the researcher was used to promote social interaction among students. The social constructivism components of the learning process were mainly generated through the interactions in this online learning environment. To provide an online social community, a Ning social network was used in this study. There were two important reasons why this particular social network was used. First, Ning, one of the most widely known content management systems (CMS), has an interface most young people are familiar with. Second, Ning is appropriate to use for both educational and social purposes. It allows not only educational content such as voting pools, discussion boards, blog posts, but also social networking tools including text, photo and video sharing, status updates, and individual profile pages. Figure 3.7 shows a screen shot from the Ning homepage for this project.

CLIMATE CHANGE PROJECT

MAIN
MY PAGE
BLOGS
FORUM
RESOURCES
QUIZ
POLLDADDY
INVITE
MY NETWORK

MEMBERS



+ Invite More View All

CC STORIES

The Realization of Global Warming

The Ice Magician

Balbuzzard and the Keys of Knowledge

Detectives Puisi et Tiphok

10 Easy Actions to Save Energy and Protect Climate

How We Know What We Know About Our Changing Climate

Protecting Our Environment

VOTE!

Based on your individual observations, do you think whether climate change/global warming is happening

Yes, it is happening and I can see it

It might be happening, but I have no clue

No, it is not happening because I cannot see anything

Vote

View Results Share This Polldaddy.com

BLOG POSTS

Thursday group process
Posted by me on March 1, 2012 at 9:30am
5 Comments 0 Likes

Please write your plans as a group. What did you download? Why did you choose it?

February 16
Posted by me on February 15, 2012 at 10:00pm
11 Comments 1 Like

Introduction Video - What is Climate Change:
<http://www.epa.gov/climatechange/kids/index.html>

CO2 Graph:
<http://nasagooe.wordpress.com/teacher-resources/interview-images-2/>

CO2 Calculation...

Continue

Module 2
Posted by me on February 11, 2012 at 5:00pm
1 Comment 0 Likes

Module Necessities

1. Make sure you develop your profile on Ning. Let us know who you are so we can create a community and learn together. Add photo and video files much like I did.
2. Post something like photos, videos etc and respond to fellow students' postings. Let them know what you think.
3. Please complete writing narrative activity. You need to write at least one or two...

Continue

Climate Change Time Machine
Posted by me on February 9, 2012 at 9:30pm
0 Comments 0 Likes

<http://climate.nasa.gov/ClimateTimeMachine/climateTimeMachine.cfm>

Carbon dioxide Concentration: Carbon dioxide (CO2) is an important heat-trapping (greenhouse) gas, which is released through human activities such as deforestation and burning fossil fuels, as well as natural processes such as respiration and volcanic eruptions. The chart on the application shows the CO2 levels in...

Continue

+ Add a Blog Post View All

ENGIN KARAHAN

Sign Out


Inbox

Alerts

Friends - invite

Settings

ABOUT

 Engin Karahan created this Ning Network.

Create a Ning Network!

QUOTES OF THE WEEK

Two thousand scientists, in a hundred countries, engaged in the most elaborate, well organized scientific collaboration in the history of humankind, have produced long-since a consensus that we will face a string of terrible catastrophes unless we act to prepare ourselves and deal with the underlying causes of global warming.

AL GORE, speech at National Sierra Club Convention, Sept. 9, 2005

FORUM

Reflections for the class technologies
Started by Engin Karahan. Last reply on Friday.
7 Replies 0 Likes

In this discussion, you are expected to provide a feedback about the technologies and the classroom projects using these technologies. Please write at least three paragraphs (each paragraph should...)

Continue

Final writing
Started by Engin Karahan. Last reply on Friday.
23 Replies 0 Likes

For this assignment, you are expected to write 2-4 paragraph for each question. While writing your essay, please consider what you have learned in this class so far such as the causes, effects, and...

Continue

Writing a narrative
Started by Engin Karahan. Last reply Mar 29.
13 Replies 0 Likes

Yesterday, you did a wonderful job, and found many good points of the causes, effects, and solutions of the Climate Change issue. However, as a possible blog writer, you need to write a narrative by...

Continue


Elevator Ride
Started by Engin Karahan. Last reply Feb 24.
14 Replies 0 Likes

LATEST ACTIVITY

What are you up to?

140 Share

commented on Engin Karahan's video

 **Prairie**

"This video talks about the prairie and whats happening to it now. a prairie is a sea of grasses that used to be all wet land. People drained the wet land so that the farmers could use it. because of this there is only 1 percent of the wet land that..."

Friday

replied to Engin Karahan's discussion

"In my opinion the things we used for the class were quite different from any other class. i never experienced a class based off of any websites but i do have to admit that i like it a lot. In our environmental science class we've used a video..."

Friday

to Engin Karahan's discussion

Figure 3.7. A Screen Capture from Ning Social Network

Students completed synchronous and asynchronous online discussions throughout the climate change unit. In addition, the website provided the students the opportunity for sharing photos, videos, and information with others. It promoted the sense of community among the members of the classroom. One of the biggest advantages of using an online learning environment was the fact that it minimized the negative effects of attendance problems, which was a common problem in the school. Students were able to visit the website to understand what happened in the classroom and to participate in discussions when they were absent.

Role of Researcher

As a researcher, I took the roles as the designer of the curriculum and online learning environment, instructor of the class, and participant observer. Prior to instruction, I designed the curriculum that was implemented throughout the quarter. During the quarter, I was the instructor of the environmental science class. At the same time, I was responsible for organizing the activities that took place in the social networking website of the class. As the media design process progressed, I moved in and out of participant and observer roles. When the students started to design their projects, a more passive role was taken to observe the actions and interactions that were occurring in the classroom. However, when necessary, I assisted the students to promote their interactions and their use of technology at the same time.

Limitations

Throughout this study, a number of limitations emerged and will be recognized in the following paragraphs. Wolcott (1990) stated that it is worthwhile to express the limitations of a study is necessary because each study has a unique nature that affects the

types of data collected and the analysis therein. There are three primary limitations that will be discussed.

The first limitation was the sample of the study. The site where this study was conducted was a school for pregnant or mother teenagers. A more heterogeneous sample in terms of gender would help the researcher to generalize the findings.

The second limitation was the fact that the researcher was also a participant observer. Even though it provided many benefits for research purposes such as controlling outside effects, it also brought limitations with it. The researcher was the instructor of the class while collecting the data at the same time. Therefore, the bias of the researcher might have affected the findings.

The last limitation was the attendance issues occurred during the semester. Some students were not able to be present in the class regularly. Even though the social network helped these students to catch up the instruction, they were not able to take part in the entire constructionist video designing process as much as others in the class.

Data Sources and Instruments

Using a mixed method approach, data was collected to provide a better understanding of the improvement on students' social/environmental awareness and activism. Seven main types of data were analyzed: Six Americas survey; student video projects; writing prompts; blog entries; video, poster, and blog projects of the students; observational field notes; and reflective journals. A timeline for the data collection is provided in Table 3.3.

Table 3.3. Timeline of data collection procedures

| Data Type | Data Source | Date |
|------------------|---------------------------------------|---|
| Quantitative | Six Americas survey | February 3 (pre-test) |
| | | March 30 (post-test) |
| Qualitative | Writing prompts | February 2 (pre-test) March 28 (post-test) |
| | Student video projects | March 30 |
| | Climate Action Plan template | March 2 |
| | Group process reports | February 23 to March 30 |
| | Student blog posts on project website | February 9 to April 6 |
| | Observational field notes | February 23 to March 30 |

Quantitative data source.

Six Americas survey. The Six Americas Survey was designed by Maibach, Leiserowitz, Roser-Renouf, and Mertz (2011) to identify audience segments for global warming public engagement campaigns. After conducting a nationally representative survey of American adults (n=2,164) in Fall 2008, the researchers identified six distinct segments, which are *alarmed*, *concerned*, *cautious*, *disengaged*, *doubtful*, and *dismissive* (see Figure 3.8). Maibach et al. (2011) describes each of these segments as follows:

Alarmed: People in this segment are very convinced about the fact that global warming is happening and it is mostly caused by human activities. They are already making changes in their lives in favor of protecting the environment and supporting an aggressive national response. This segment is the strongest one involving both social/environmental awareness and activism.

Concerned: People in this segment believe that global warming is a serious problem. Although they support a national response, they are less involved in the problem both personally and socially. This segment involves social/environmental awareness, but it shows lack of activism.

Cautious: This segment involves people who also believe that global warming is a problem, although they are less certain that it is happening than the Alarmed or the Concerned. They do not believe that the problem is neither serious nor urgent. That's why they don't deal with the problem personally or socially.

Disengaged: People in this segment haven't thought much about the global warming issue. They most likely say that they could easily change their minds about global warming. People who are disengaged usually select the "don't know" option in response to every possible survey question about global warming.

Doubtful: Many within this group believe that if global warming is happening, it is caused by natural changes in the environment not the human activities. They think it won't have negative effects on people for many decades into the future, if at all, and America is already doing enough to respond to the threat. People in this segment are evenly split among those who think global warming is happening, those who think it isn't, and those who don't know.

Dismissive: This segment includes people who are actively engaged in the issue like the others in the Alarmed segment, but on the opposite end of the spectrum. The large majority of the people in this segment believe that global warming is not happening, is not a threat to either people or non-human nature, and is not a problem that warrants a personal or societal response.



Figure 3.8. The Audience Segments of Six Americas Survey

Maibach, Leiserowitz, Roser-Renouf, Mertz, and Akerlof (2011) described two survey tools, a 36-item instrument and a 15-item instrument. Eliminating the 21 least predictive variables from the 36-item instrument, researchers developed the 15-item instrument for a shorter – and therefore more easily used – screening questionnaire capable of classifying members of independent samples into the six audience segments with 80% accuracy or better. These tools were created using linear discriminant functions to identify Six Americas segment status. They report that “the discriminant analysis using the 36-item instrument correctly classifies 90.6% of the sample (as compared to the original Latent Class Analysis results); accuracy varies by segment, ranging from 79% to 99%. The 15-item instrument correctly classified 84% of the sample, ranging by segment from 60% to 97%” (p. 3). In this particular study, the 15-item instrument was used to measure students’ awareness and beliefs about climate change. The survey was administered as pre-test and post-test.

Qualitative data sources.

Writing prompts. At the beginning and the end of the unit, students were asked to provide a written response to the following questions, “Why do we need to care about the environment?” and “How (in what ways) can we protect it?” Although there were two questions to keep students on track, the questions were chosen very broad in purpose to allow students to express their knowledge and beliefs completely. Students were asked to

write their prompts during the class time, but there was no time limit. At the beginning of both pre- and post-writing prompt activities, students were told that there is no right or wrong answer for this particular writing activity. Even though they were told that these prompts did not affect their grades, they were strongly motivated to take the activity seriously. These reminders helped the students to be more comfortable with their responses. Considering the second language learners in the classroom, all the students were provided 2 class period and the language support, if needed.

Student video design projects. The video projects designed by the students were analyzed qualitatively based on the content. One of the main goals for analyzing these videos qualitatively was to see how students express their awareness and activism. To achieve this, the videos were coded, and then analyzed in terms of the content derived from the visual elements and texts in the videos. The visual elements in the videos gave a unique opportunity to see students' awareness and activism because they sometimes struggle to express awareness and activism via written texts.

Climate change action plan template. To explore students' expressions of awareness and activism with regard to the issue of Climate Change, the Climate Change action plan template from 9-12 grades curriculum of Will Steger Foundation was employed. Minnesota's Changing Climate curriculum project designed by Will Steger Foundation involves engaging content on Minnesota's natural environment (i.e. biomes) and the impacts of climate change. The curriculum includes lesson plans for grades 3-12, as well as an online classroom with video, audio and interactive content. The Climate Change Action Plan was located at the end of the curriculum or 9-12 grades.

The Climate Action Plan was completed as an in-class activity to understand the progress of students in terms of expressing social and environmental awareness and activism at the middle of the quarter. The document involves the following questions: (1) What issue are you most passionate about regarding the impacts of climate change in Minnesota? Why?, (2) What do you want to see change at your school and/or what does your school or community need to do to help mitigate or adapt to the impacts of climate change?, (3) What connections do you see between your passions and the needs of your school/community?, and (4) Use the space below to jot ideas for potential projects based on the previous questions and your participation in workshops/discussions.

Student blog posts on the social networking website. Students participated in online discussions and wrote blog posts regularly during the quarter. These blog posts offered an opportunity to see the progress of students' forms of expressing awareness and activism with regard to environmental issues. In addition, the fact that the students responded to each other's posts created a very effective social interaction among the students (see figure 3.9 for a sample blog post). Using an online learning environment for blog posts offered three important benefits. First, the researcher had a chance to see students' posts and the responses in a very organized way including time and date. Second, the students had a chance to think about the topic longer and to read others' posts to improve their statements. Lastly, the students who had attendance problems were able to participate in the discussions and to express their statements. In addition to showing students' environmental awareness and activism, the blog posts also provided evidence for how they promoted each other's expressions, understandings, and attitudes with regard to environmental problems.

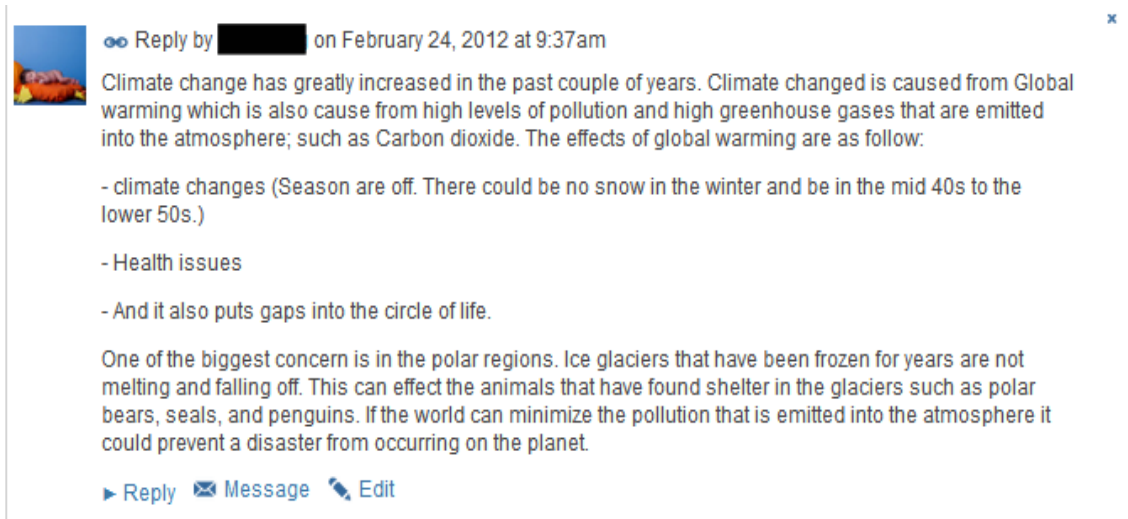


Figure 3.9. An example of a blog post discussion on the website

Group progress reports. During the media design process, each design group was asked to write a group progress report at the end of the each week. Students first discussed their progress in their design groups, and then one of the students recorded the discussions. Students were advised to include their progress for the week and their plans for the following week.

Observational field notes. This particular data set included the observations of the researcher and the interactions between the researcher and the students. The researcher's role in the class as both instructor and designer of the learning environment gave a unique opportunity to observe the media design process. The observational field notes were taken every week throughout the design process. The fact that observational field notes and the group process reports were triangulated based on their date made them stronger and more reliable.

Data Analysis

Quantitative data analysis. The R Statistical Software version 2.15.0 was used to analyze the quantitative data. The pre- and post-test results of the Six Americas survey

were analyzed with paired sample t-test to compare scores in the Six Americas Survey in pre-test and post-test. Before conducting the paired sample t-test, the assumptions of normality for t-test data were checked for pre-test, post-test scores, and mean differences. In addition, each question in the survey was discussed with descriptive statistics.

Qualitative data analysis. Qualitative data analyses were done through the use of NVivo 9.0 software. NVivo 9.0 is qualitative data analysis software that allows the researcher to transform data in a myriad of ways that assist in data analysis. To analyze the data, Miles and Huberman (1994)'s general analysis framework was employed (see Figure 3.10). This framework includes data reduction, data display, conclusion drawing, and verification. After the manipulations had been made on the qualitative data, all the qualitative data was uploaded into NVivo 9.0 software. Data reduction, displaying, conclusion drawing and triangulation were done in part through the use of NVivo9.0 software. By using this approach, rich descriptions were elicited that captured the essence of the phenomenon in question from substantial raw data sources.

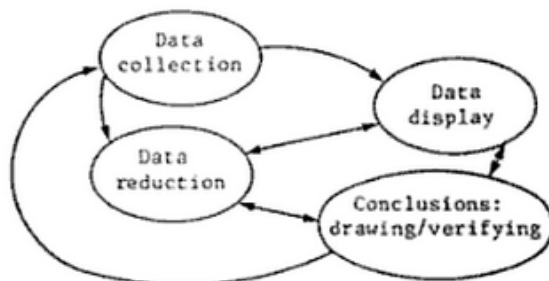


Figure 3.10. Components of Data Analysis: Interactive Model

The qualitative data was analyzed by using the qualitative thematic approach outlined by van Manen (1990). He stated that there are three approaches toward uncovering or isolating thematic aspects of a phenomenon in some text: the holistic or sententious

approach, the selective or highlighting approach, and the detailed or line-by-line approach. Van Manen (1990) further describes each of these processes in the following manner:

1. In the [holistic] reading approach, we attend to the text as a whole and ask, What sententious phrase may capture the fundamental meaning or main significance of the text as a whole? We then try to express that meaning by formulating such a phrase.
2. In the selective reading approach, we listen to or read a text several times and ask, What statement(s) or phrase(s) seem particularly essential or revealing about the phenomenon or experience being described? These statements we then circle, underline, or highlight.
3. In the detailed reading approach, we look at every single sentence or sentence cluster and ask, What does this sentence or sentence cluster reveal about the phenomenon or experience being described? (p. 93)

First, I used selective reading approach, reading my qualitative data several times to find themes and patterns. After intensive reading process, I created a tree organization of my nodes including parent, children, and grandchildren nodes in NVivo based on these themes and patterns. While organizing the data based on my model, I decided to eliminate some of the nodes or to combine different nodes that could be considered as one. After creating a tree organization of nodes, I reread the qualitative data documents again and found extra themes. Since they were worthy to analyze, I created free nodes that are not really belong to the tree organization of nodes.

Validity and reliability. Eisner and Peshkin (1990) described validity as “the congruence of the researcher’s claims to the reality his or her claims seek to represent” (p. 97). There are three kinds of validity considered in this study.

Construct validity. The structural validity of this study was granted by employing more than one data collection method. Also, the results were discussed with the classroom teacher who was also at the research site during the study.

Internal validity. Using at least two validation strategies of the possible is recommended by Creswell (2007). In this study, two different validation strategies were employed. The first one was triangulation which is considered one of the strongest validation methods. A variety of data sources were used in this study to answer the research questions. The codes that emerged within one data source were considered with other data sources to support or disprove the validity of the naturalistic code, essentially triangulating the code against multiple data sources. The second validation strategy used in this study was to provide readers rich and thick descriptions in order to increase the level of transparency. The readers can draw their own conclusions based on the descriptions provided by the researcher, and then they can compare their conclusions with the ones the researcher came through.

External validity. Because of the nature of a case study whose sample size is limited, this study cannot be generalized to bigger samples statistically.

Internal reliability. The internal reliability in this study was provided with these actions: (1) The data coming from qualitative sources such as observations, writing prompts, and blog posts were supported with direct quotes of the participants, (2) the data coming from researcher perspective was triangulated with the other data from

participants, and (3) inter coder reliability methods were employed. Miles and Huberman (1994) explain how to provide inter coder reliability as follows:

Check coding not only aids definitional clarity but also is a good reliability check...The best advice here is for more than one person to code, separately, 5-10 pages of the first set of transcribed field notes and then to review each rendition together (p. 64).

For this study, 20% of the qualitative data was coded by another researcher in science education field. Then, the each version was reviewed together to see if the congruity between these two code sets are higher than 80%.

External reliability. To provide external reliability in this study, the criteria listed were considered: (1) The participants of the study were described in detail to help other researchers to decide their sample and (2) Research design, instructional intervention, data collection and analysis, and results were described very clearly.

Conclusion

During the instructional and media design process, both qualitative and quantitative data was collected. Based on convergent design of mixed methods, qualitative and quantitative data was combined to get more reliable results. Convergent design of mixed methods helped the researcher to combine the powerful ways of qualitative and quantitative methods of inquiry and to compensate for the weaknesses of these methods. Even though there were attendance problems for different individuals, all the students participated in most parts of both the instructional and media design processes. During the quarter, a variety of data was collected. The data coming from Six Americas survey and media design rubric was analyzed quantitatively whereas writing prompts, climate action plan template, group process reports, student blog posts, and

observational field notes were analyzed qualitatively. In the following chapter, students' responses to blog and written prompts, media projects, surveys, and other classroom artifacts are described.

Chapter IV: Analysis and Results

The primary purpose of this study is to investigate the effects of constructionist and social constructivist methods on high school students' environmental awareness and activism related to the specific topic of global climate change. For this purpose, both qualitative and quantitative data collection methods were employed. Quantitative data included a modified version of the Six Americas Survey (Maibach, Leiserowitz, Roser-Renouf, & Mertz, 2011). Qualitative data included writing prompts, blog entries, students' video projects, observational field notes, and reflective journals. The findings from both the quantitative and qualitative data sources are described in this chapter.

Quantitative Data

Six Americas survey.

To provide a more in-depth analysis for students' responses to survey questions, the 15-item instrument was investigated under four categories: belief items, issues involvement items, behavior items, and preferred societal response items. Under these categories, the responses of students on each question are explained individually.

Belief items. Under this section, students' responses to the survey questions related to their belief about environmental problems, particularly global warming, are investigated in-depth. The belief items involved questions about *certainty that global warming is occurring, human causation, personal risk, timing of harm to Americans, risk to future generations, and ability of humans to successfully mitigate global warming* (see Table 4.1).

Table 4.1. Descriptive statistics and distribution of segments of the questions in belief

items

| Survey Questions | Belief Items | | | | | | | | | | | | | | Scale |
|---|--------------|-------------|------------|--------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|-------------|--------------|-------|
| | Alarmed | | Concerned | | Cautious | | Disengaged | | Doubtful | | Dismissive | | General | | |
| | Pre n=0 | Post n=2 | Pre n=5 | Post n=11 | Pre n=7 | Post n=2 | Pre n=3 | Post n=2 | Pre n=2 | Post n=0 | Pre n=0 | Post n=0 | Pre | Post | |
| 1. & 1a. Certainty global warming is | N/A | 8.50 | 8.20 | 8.27 | 6.14 | 8.00 | 7.66 | 8.50 | 7.50 | N/A | N/A | N/A | 7.17 | 8.30 | 9 |
| 2. Human causation (% agree) | N/A | 100 | 100 | 100 | 14.28 | 0 | 0 | 100 | 0 | N/A | N/A | N/A | 35.3 | 88.23 | - |
| 4. Personal risk | N/A | 4.00 | 1.80 | 2.82 | 1.43 | 1.50 | 1.00 | 1.50 | 2.00 | N/A | N/A | N/A | 1.53 | 2.65 | 4 |
| 5. Timing of harm to Americans | N/A | 6.00 | 4.80 | 5.36 | 5.00 | 5.00 | 2.66 | 6.00 | 4.00 | N/A | N/A | N/A | 4.41 | 5.47 | 6 |
| 6. Risk to future generations | N/A | 4.00 | 4.00 | 3.73 | 3.28 | 3.00 | 0.00 | 0.00 | 1.5 | N/A | N/A | N/A | 2.70 | 3.24 | 4 |

| | | | | | | | | | | | | | | | |
|---|-----|------|------|------|------|-----|------|-----|------|-----|-----|-----|-------------|-------------|---|
| 11. Ability of humans to successfully mitigate global | N/A | 3.50 | 3.20 | 3.18 | 3.14 | 2.5 | 3.66 | 3.5 | 2.00 | N/A | N/A | N/A | 3.12 | 3.18 | 5 |
|---|-----|------|------|------|------|-----|------|-----|------|-----|-----|-----|-------------|-------------|---|

Table 4.1 shows that there was an obvious difference between post and pre-test scores on all questions. The biggest increase was observed in question 2, which was about human causation on global warming, whereas the ability of humans to successfully mitigate global warming showed the least increase.

The first belief item (question 1 on the survey) measured students' certainty about the occurrence of global warming. The comparison of pre- and post-test results provided evidence that students' belief about the occurrence of global warming moved to more certain levels such as extremely and very sure after the learning process (see Table 4.2). The pre-test results showed that most students were somewhat sure that global warming happening. Even though most of the students believed the existence of global warming in different degrees, there were some students who stated that whether they did not know or they were somewhat sure about that global warming is not happening. On the other hand, post-test results showed that all the students were extremely, very or somewhat sure about the existence of global warming. Also, there was not any student who believed the non-existence of global warming.

Table 4.2. Percentile rate of students' responses for Question 1

| |
|---|
| Do you think global warming is happening? |
|---|

| | Pre | Post |
|---|-------|-------|
| | % | % |
| Extremely sure global warming is happening | 23.52 | 41.18 |
| Very sure global warming is happening | 17.65 | 47.06 |
| Somewhat sure global warming is happening | 35.29 | 11.76 |
| Not at all sure global warming is happening | 11.76 | 0.00 |
| Don't know | 5.88 | 0.00 |
| Not at all sure global warming is not happening | 0.00 | 0.00 |
| Somewhat sure global warming is not happening | 5.88 | 0.00 |
| Very sure global warming is not happening | 0.00 | 0.00 |
| Extremely sure global warming is not happening | 0.00 | 0.00 |

The second belief item (survey question 2) aimed to show students' perspectives about the human causation on global warming. The item was investigated based on the percentages of responses. The pre-test results showed that number of students who believed that global warming is caused by human activities, natural changes in the environment or some other reasons were so close to each other (see Table 4.3). However, students' responses on the post-test indicated that 88.24% of the students were convinced that global warming is caused mostly by human activities.

Table 4.3. Percentile rate of students' responses for Question 2

| Assuming global warming is happening, do you think it is ... | | |
|--|-------|-------|
| | Pre | Post |
| | % | % |
| Caused mostly by human activities | 35.30 | 88.24 |
| Caused mostly by natural changes in the environment | 35.30 | 5.88 |
| Other | 29.41 | 5.88 |
| None of the above because global warming isn't happening | 0.00 | 0.00 |

The third beliefs item (survey question 4) measured students’ beliefs about the potential personal risks of global warming. The pre-test results showed that the students’ responses distributed among all choices (see Table 4.4). However, the post-test findings showed that most of the students believed that global warming will harm them personally in a great deal or a moderate amount. The rest of the students in the post-test selected the “don’t know” option. Another finding that emerged from this particular item was that no student stated that global warming will not harm them at all or it will harm them only a little.

Table 4.4. Percentile rate of students’ responses for Question 4

| How much do you think global warming will harm you personally? | | |
|--|-------|-------|
| | Pre | Post |
| | % | % |
| A great deal | 5.88 | 35.29 |
| A moderate amount | 23.53 | 41.18 |
| Only a little | 23.53 | 0.00 |
| Not at all | 11.76 | 0.00 |
| Don’t know | 35.29 | 23.53 |

The next question in belief items (survey question 5) measured when students’ believed global warming would cause harm to people in the United States. The pre-test results indicated that even though 41.18% of the students believed that people in the US are being harmed right now, their responses were scattered among different choices (see Table 4.5). On the other hand, post-test results showed that students’ belief about the time people in the US would be harmed by global warming mostly fell under the shorter range, from recent to 25 years. The percentage of students who believed that people in the US are being harmed now increased from 41.18% to 64.70%. More importantly, no student believed that people in the US will never be harmed.

Table 4.5. Percentile rate of students’ responses for Question 5

| When do you think global warming will start to harm people in the United States? | | |
|--|-------|-------|
| | Pre | Post |
| | % | % |
| They are being harmed now | 41.18 | 64.70 |
| 10 years | 17.65 | 17.65 |
| 25 years | 11.76 | 17.65 |
| 50 years | 11.76 | 0.00 |
| 100 years | 5.88 | 0.00 |
| Never | 11.76 | 0.00 |

The next item in the beliefs category (survey question 6) provided information about students’ belief about the effects of global warming on future generations. Similar to the previous item, students’ responses on the pre-test were observed for all choices (see Table 4.6). However, “a great deal” was the most-chosen response. Post-test responses indicated that students did not believe that either global warming will not harm future generations nor have only minimal effects. However, there were still some students who had no idea about the negative effects of global warming on future generations.

Table 4.6. Percentile rate of students’ responses for Question 6

| How much do you think global warming will harm future generations of people? | | |
|--|-------|-------|
| | Pre | Post |
| | % | % |
| A great deal | 47.06 | 58.82 |
| A moderate amount | 17.65 | 29.41 |
| Only a little | 11.76 | 0.00 |
| Not at all | 5.88 | 0.00 |
| Don’t know | 17.65 | 11.76 |

The last question in belief items (survey question 11) aimed to show students’ opinions about the ability of humans to successfully mitigate global warming. Both pre- and post-test results showed that students’ responses mostly fell into the response stating

that although humans could reduce global warming, they are not willing to take actions in favor of preventing global warming (see Table 4.7). Students also believed that it is not clear what is needed to prevent global warming at this point. Interestingly, students who believed that humans can reduce global warming, and it will be done successfully, moved to more pessimistic beliefs about mitigating global warming. Additionally, students' beliefs switched to more pessimistic points of views about ability of humans to successfully mitigate global warming in the post-test responses of the students.

Table 4.7. Percentile rate of students' responses for Question 11

| Which of the following statements comes closest to your view? | | |
|---|-------|-------|
| | Pre | Post |
| | % | % |
| Humans can reduce global warming, and we are going to do so successfully | 5.88 | 0.00 |
| Humans could reduce global warming, but it's unclear at this point whether we will do what's needed | 23.53 | 29.41 |
| Humans could reduce global warming, but people aren't willing to change their behavior, so we're not going to | 52.94 | 58.82 |
| Humans can't reduce global warming, even if it is happening | 11.76 | 11.76 |
| Global warming isn't happening | 5.88 | 0.00 |

Issues involvement items. In this section, the questions that assessed students' involvement with the global warming issue were analyzed. The questions addressed *worry about global warming, thought given to global warming, personal importance of the issue, unwillingness to change opinion, and friends share views on global warming.* In this section, the difference between pre- and post-test results is explained for each question under this category.

The analysis of these items showed that a positive difference was present in each questions (see Table 4.8). The biggest difference was observed for the item that showed the personal importance of global warming issue.

Table 4.8. Descriptive statistics and distribution of segments of the questions in issues involvement items

| Survey Questions | Issues Involvement Items | | | | | | | | | | | | General | | Scale |
|------------------------------------|--------------------------|-------------|------------|--------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|---------|------|-------|
| | Alarmed | | Concerned | | Cautious | | Disengaged | | Doubtful | | Dismissive | | | | |
| | Pre n=0 | Post n=2 | Pre n=5 | Post n=11 | Pre n=7 | Post n=2 | Pre n=3 | Post n=2 | Pre n=2 | Post n=0 | Pre n=0 | Post n=0 | Pre | Post | |
| 3. Worry about global warming | N/A | 3.00 | 3.20 | 3.18 | 2.28 | 3.00 | 2.66 | 3.00 | 2.5 | N/A | N/A | N/A | 2.64 | 3.12 | 4 |
| 7. Thought given to global warming | N/A | 2.50 | 2.40 | 2.82 | 2.00 | 2.50 | 1.66 | 2.5 | 1.5 | N/A | N/A | N/A | 2.00 | 2.70 | 4 |
| 8. Personal importance of issue | N/A | 4.00 | 3.00 | 3.45 | 2.71 | 3.00 | 1.66 | 3.00 | 2.0 | N/A | N/A | N/A | 2.53 | 3.41 | 4 |
| 9. Unwilling to change opinion | N/A | 4.00 | 2.60 | 2.91 | 2.28 | 2.00 | 2.33 | 2.00 | 2.5 | N/A | N/A | N/A | 2.41 | 2.82 | 5 |

| | | | | | | | | | | | | | | | |
|---|-----|------|------|------|------|------|------|------|-----|-----|-----|-----|-------------|-------------|---|
| 10. Friends share views on global warming | N/A | 2.50 | 1.60 | 2.18 | 1.43 | 2.50 | 1.66 | 2.50 | 3.0 | N/A | N/A | N/A | 1.70 | 2.30 | 5 |
|---|-----|------|------|------|------|------|------|------|-----|-----|-----|-----|-------------|-------------|---|

The first question in the issues involvement items (survey question 3) measured how worried students were about global warming. Pre-test results showed that most students stated that they were either somewhat or not very worried about global warming (see Table 4.9). However, in their post-test responses, 88.24% of the students indicated that they were somewhat worried about global warming. Additionally, none of the students stated that they were not very worried about global warming in their post-test responses.

Table 4.9. Percentile rate of students’ responses for Question 3

| How worried are you about global warming? | | |
|---|-------|-------|
| | Pre | Post |
| | % | % |
| Very worried | 5.88 | 11.76 |
| Somewhat worried | 52.94 | 88.24 |
| Not very worried | 41.18 | 0.00 |
| Not at all worried | 0.00 | 0.00 |

The second issues involvement item (survey question 7) measured students’ involvement on the global warming issue and aimed to show the thought given to global warming by the students. The comparison of pre- and post-test responses of students showed an increase on thought given to global warming. Pre-test results showed that 35.29% of the students had not thought about global warming at all, whereas the rest of the students had given a little or some thought (see Table 4.10). On the other hand, post-

test results indicated that students who had not thought about global warming before the pre-test selected other choices which addressed having thought about global warming before.

Table 4.10. Percentile rate of students' responses for Question 7

| How much had you thought about global warming before today? | | |
|---|-------|-------|
| | Pre | Post |
| | % | % |
| A lot | 0.00 | 11.76 |
| Some | 35.29 | 47.06 |
| A little | 29.41 | 41.18 |
| Not at all | 35.29 | 0.00 |

The third issues involvement item (survey question 8) focused on the personal importance of global warming. Both pre- and post-test results showed that there were not any students who stated that global warming is extremely important to them personally (see Table 4.11). In pre-test, although most students chose that global warming is somewhat important to them personally, 23.53% of the students stated that it is not important at all to them personally. On the other hand, post-test results showed that 94.12% of the students stated that global warming is very or somewhat important to them personally.

Table 4.11. Percentile rate of students' responses for Question 8

| How important is the issue of global warming to you personally? | | |
|---|-------|-------|
| | Pre | Post |
| | % | % |
| Extremely important | 0.00 | 0.00 |
| Very important | 11.76 | 47.06 |
| Somewhat important | 52.94 | 47.06 |
| Not too important | 11.76 | 0.00 |
| Not at all important | 23.53 | 5.88 |

The fourth issues involvement item (survey question 9) was designed to show students' unwillingness to change their opinion about global warming. Both pre- and post-test responses of students indicated that students mostly somewhat agree or disagree about changing their mind about global warming (see Table 4.12). However, the percentage of students unwilling to change their mind about global warming choices increased in post-test results.

Table 4.12. Percentile rate of students' responses for Question 9

| How much do you agree or disagree with the following statement: "I could easily change my mind about global warming." | | |
|---|-------|-------|
| | Pre | Post |
| | % | % |
| Strongly disagree | 5.88 | 17.65 |
| Somewhat disagree | 47.06 | 52.94 |
| Somewhat agree | 29.41 | 23.53 |
| Strongly agree | 17.65 | 5.88 |

The last question in issues involvement items (survey question 10) asked about the number of friends who share the same view with students on global warming. There were no students who stated that all friends share their views on global warming in either pre- or post-test results (see Table 4.13). However, an increase in the number of friends sharing their views on global warming was observed between pre- and post-test responses.

Table 4.13. Percentile rate of students' responses for Question 10

| How many of your friends share your views on global warming? | | |
|--|------|-------|
| | Pre | Post |
| | % | % |
| All | 0.00 | 0.00 |
| Most | 5.88 | 5.88 |
| Some | 0.00 | 29.41 |

| | | |
|-------|-------|-------|
| A few | 52.94 | 52.94 |
| None | 41.18 | 11.76 |

Behavior items. Behavior items were designed to reflect students’ behaviors in terms of global warming. In the 15-item Six Americas survey, there was only one question that showed students behaviors related to global warming (see Table 4.14).

Table 4.14. Descriptive statistics and distribution of segments of the questions in behavior items

| Survey Questions | Behavior Items | | | | | | | | | | | | Scale | | |
|--|----------------|-------------|------------|--------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|-------------|-------------|------|
| | Alarmed | | Concerned | | Cautious | | Disengaged | | Doubtful | | Dismissive | | | General | |
| | Pre n=0 | Post n=2 | Pre n=5 | Post n=11 | Pre n=7 | Post n=2 | Pre n=3 | Post n=2 | Pre n=2 | Post n=0 | Pre n=0 | Post n=0 | | Pre | Post |
| 13. Punished companies that are not reducing emissions | N/A | 0.50 | 0.60 | 1.36 | 1.00 | 1.00 | 1.00 | 1.00 | 0.50 | N/A | N/A | N/A | 0.82 | 1.18 | 5 |

Students’ responses on the only behavior item (survey question 13) indicated the frequency of actions students take to punish companies who are not reducing emissions. In both pre- and post-test responses, most of the students stated that they had never punished those kinds of companies (see Table 4.15). Moreover, the percentage of the choices indicating that they punished companies were very low in both pre- and post-tests.

Table 4.15. Percentile rate of students' responses for Question 13

| Over the past 12 months, how often have you punished companies that are opposing steps to reduce global warming by NOT buying their products? | | |
|---|-------|-------|
| | Pre | Post |
| | % | % |
| Many times (6+) | 0.00 | 0.00 |
| Several times (4-5) | 0.00 | 5.88 |
| A few times (2-3) | 0.00 | 5.88 |
| Once | 5.88 | 5.88 |
| Never | 70.59 | 64.70 |
| Don't know | 23.53 | 17.65 |

Preferred societal response items. The questions under preferred societal response items category aimed to reflect students' perspectives about *the amount of actions citizens should take to reduce global warming, priority of global warming for president and congress, and contingent international conditions for US mitigation action.*

Table 4.16 shows that there was a positive increase on each question in this category.

Table 4.16. Descriptive statistics and distribution of segments of the questions in preferred societal response items

| Survey Questions | Preferred Societal Response Items | | | | | | | | | | | | Scale | | |
|------------------|-----------------------------------|-------------|------------|--------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|-------|---------|------|
| | Alarmed | | Concerned | | Cautious | | Disengaged | | Doubtful | | Dismissive | | | General | |
| | Pre n=0 | Post n=2 | Pre n=5 | Post n=11 | Pre n=7 | Post n=2 | Pre n=3 | Post n=2 | Pre n=2 | Post n=0 | Pre n=0 | Post n=0 | | Pre | Post |
| | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | |
|--|-----|------|------|-------|------|------|------|------|------|-----|-----|-----|-------------|--------------|---|
| 12. Citizens should do more/less to reduce global warming | N/A | 5.00 | 4.60 | 4.45 | 3.57 | 3.50 | 3.66 | 4.00 | 3.00 | N/A | N/A | N/A | 3.82 | 4.35 | 5 |
| 14. Priority of global warming for president & Congress | N/A | 4.00 | 2.40 | 3.36 | 2.57 | 3.00 | 2.66 | 2.5 | 1.00 | N/A | N/A | N/A | 2.35 | 3.30 | 4 |
| 15. Contingent int'l conditions for US mitigation action (% regardless of actions) | N/A | 100 | 0.00 | 54.55 | 0.00 | 0.00 | 0.00 | 50.0 | 0.00 | N/A | N/A | N/A | 0.00 | 52.94 | - |

The first item in the preferred societal response category (survey question 12) showed students' opinions about the actions that need to be taken by citizens to address global warming. The percentage of students who stated that citizens themselves should be doing more or much more to address global warming in post-test responses was much

more than pre-test (see Table 4.17). Moreover, there were no students who stated that citizens should do either less or much less to address global warming in pre- or post-tests.

Table 4.17. Percentile rate of students’ responses for Question 12

| Do you think citizens themselves should be doing more or less to address global warming? | | |
|--|-------|-------|
| | Pre | Post |
| | % | % |
| Much more | 17.65 | 41.18 |
| More | 47.06 | 52.94 |
| Currently doing the right amount | 35.29 | 5.88 |
| Less | 0.00 | 0.00 |
| Much less | 0.00 | 0.00 |

Another second preferred societal response item (survey question 14) reflected students’ opinions about the priority of global warming for the President and Congress. Pre-test results showed that 17.65% of the students believed that global warming should be a low priority for the next president and congress, whereas there was no student who selected this choice in post-test (see table 4.18). In addition, the percentages of students who thought that global warming should be high or very high priority for the next president and congress in post-test were higher than the percentages in pre-test.

Table 4.18. Percentile rate of students’ responses for Question 14

| Do you think global warming should be a low, medium, high, or very high priority for the next president and Congress? | | |
|---|-------|-------|
| | Pre | Post |
| | % | % |
| Very high | 5.88 | 35.29 |
| High | 41.18 | 58.82 |
| Medium | 35.29 | 5.88 |
| Low | 17.65 | 0.00 |

The last preferred societal response item (survey question 15) reflected students’ perspectives about whether or not the United States should reduce its greenhouse gas

emissions. Students' responses in pre-test showed that although none of the students stated that the US should reduce its greenhouse gas emissions regardless of what other countries do, 52.94% of the students selected this choice in their post-test responses (see Table 4.19). Moreover, 29.41% of the students stated that the US should not reduce its emissions in pre-test, whereas there was not any student who chose it in post-test.

Table 4.19. Percentile rate of students' responses for Question 15

| 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? The United States should reduce its greenhouse gas emissions ... | | |
|---|-------|-------|
| | Pre | Post |
| | % | % |
| Regardless of what other countries do | 0.00 | 52.94 |
| Only if other industrialized countries (such as England, Germany and Japan) reduce their emissions | 17.65 | 11.76 |
| Only if other industrialized countries and developing countries (such as China, India and Brazil) reduce their emissions | 11.76 | 11.76 |
| The US should not reduce its emissions | 29.41 | 0.00 |
| Don't know | 41.18 | 23.53 |

Analysis of quantitative data.

Students completed the modified Six Americas survey at the beginning and end of the quarter. This 15-item version of Six Americas Survey originally developed by the Yale Project on Climate Change Communication, measured students' attitudes and beliefs about global warming and related policy making. Student responses were categorized into one of six categories (see Figure 4.1).

The analysis of the students' responses on the Six Americas survey provided quantitative evidence for the improvement of students' environmental awareness and activism. Pre-test results showed that the students fell into the following categories: two

in *Doubtful*, three in *Disengaged*, seven in *Cautious*, and five in *Concerned*; whereas post-test results indicated that the students were redistributed into the following categories: two in *Disengaged*, two in *Cautious*, eleven in *Concerned*, and two in *Alarmed* (see Table 4.20). Both pre- and post-survey results showed that there were no students under the *Dismissive* category. Even though there were not any student in the *Alarmed* segment before the learning process, post-survey results showed that two students fell into this segment at the end of the quarter.

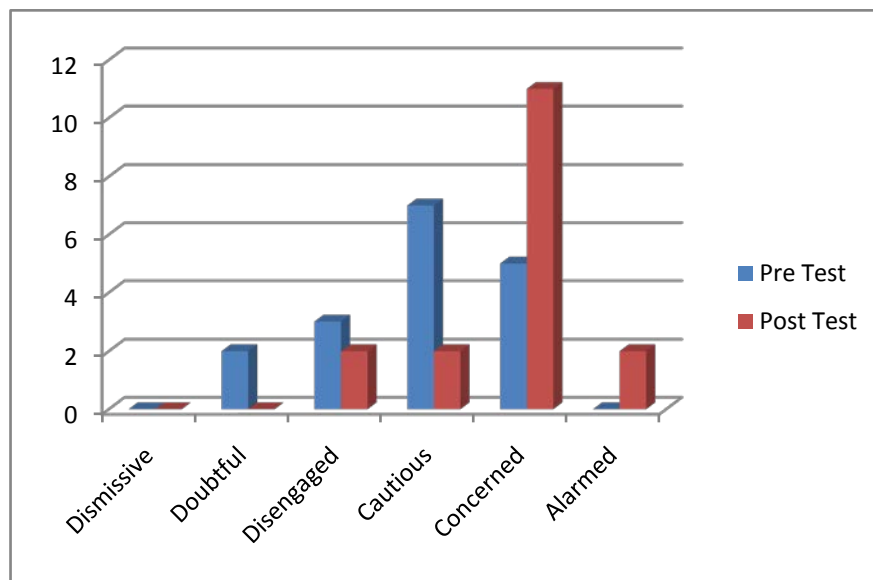


Figure 4.1. The distribution of students in six segments

Table 4.20. The descriptive statistics of students’ responses for each segment

| Survey Questions | Audience Segment | | | | | | | | | | | | | | Scale |
|--|------------------|-------------|------------|--------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|-------------|--------------|-------|
| | Alarmed | | Concerned | | Cautious | | Disengaged | | Doubtful | | Dismissive | | General | | |
| | Pre n=0 | Post n=2 | Pre n=5 | Post n=11 | Pre n=7 | Post n=2 | Pre n=3 | Post n=2 | Pre n=2 | Post n=0 | Pre n=0 | Post n=0 | Pre n=17 | Post n=17 | |
| 1. & 1a. Certainty global warming is occurring | N/A | 8.50 | 8.20 | 8.27 | 6.14 | 8.00 | 7.66 | 8.50 | 7.50 | N/A | N/A | N/A | 7.17 | 8.30 | 9.00 |
| 2. Human causation (% agree) | N/A | 100 | 100 | 100 | 14.28 | 0 | 0 | 100 | 0 | N/A | N/A | N/A | 35.30 | 88.23 | - |
| 3. Worry about global warming | N/A | 3.00 | 3.2 | 3.18 | 2.28 | 3.00 | 2.66 | 3.00 | 2.5 | N/A | N/A | N/A | 2.64 | 3.12 | 4.00 |
| 4. Personal risk | N/A | 4.00 | 1.80 | 2.82 | 1.43 | 1.50 | 1.00 | 1.50 | 2.00 | N/A | N/A | N/A | 1.53 | 2.65 | 4.00 |
| 5. Timing of harm to Americans | N/A | 6.00 | 4.80 | 5.36 | 5.00 | 5.00 | 2.66 | 6.00 | 4.00 | N/A | N/A | N/A | 4.41 | 5.47 | 6.00 |
| 6. Risk to future generations | N/A | 4.00 | 4.00 | 3.73 | 3.28 | 3.00 | 0.00 | 0.00 | 1.5 | N/A | N/A | N/A | 2.70 | 3.24 | 4.00 |
| 7. Thought given to global warming | N/A | 2.50 | 2.40 | 2.82 | 2.00 | 2.50 | 1.66 | 2.5 | 1.5 | N/A | N/A | N/A | 2.00 | 2.70 | 4.00 |
| 8. Personal importance of issue | N/A | 4.00 | 3.00 | 3.45 | 2.71 | 3.00 | 1.66 | 3.00 | 2.00 | N/A | N/A | N/A | 2.53 | 3.41 | 4.00 |
| 9. Unwilling to change opinion | N/A | 4.00 | 2.60 | 2.91 | 2.28 | 2.00 | 2.33 | 2.00 | 2.50 | N/A | N/A | N/A | 2.41 | 2.82 | 5.00 |

| | | | | | | | | | | | | | | | |
|---|-----|------|------|-------|------|------|------|------|------|-----|-----|-----|-------------|--------------|------|
| 10. Friends share views on global warming | N/A | 2.50 | 1.60 | 2.18 | 1.43 | 2.50 | 1.66 | 2.50 | 3.00 | N/A | N/A | N/A | 1.70 | 2.30 | 5.00 |
| 11. Ability of humans to successfully mitigate global warming | N/A | 3.50 | 3.20 | 3.18 | 3.14 | 2.5 | 3.66 | 3.5 | 2.00 | N/A | N/A | N/A | 3.12 | 3.18 | 5.00 |
| 12. Citizens should do more/less to reduce warming | N/A | 5.00 | 4.60 | 4.45 | 3.57 | 3.50 | 3.66 | 4.00 | 3.00 | N/A | N/A | N/A | 3.82 | 4.35 | 5.00 |
| 13. Punished companies that are not reducing emissions | N/A | 0.50 | 0.60 | 1.36 | 1.00 | 1.00 | 1.00 | 1.00 | 0.50 | N/A | N/A | N/A | 0.82 | 1.18 | 5.00 |
| 14. Priority of global warming for president & Congress | N/A | 4.00 | 2.40 | 3.36 | 2.57 | 3.00 | 2.66 | 2.5 | 1.00 | N/A | N/A | N/A | 2.35 | 3.30 | 4.00 |
| 15. Contingent int'l conditions for US mitigation action (% regardless of actions of other countries) | N/A | 100 | 0.00 | 54.55 | 0.00 | 0.00 | 0.00 | 50.0 | 0.00 | N/A | N/A | N/A | 0.00 | 52.94 | - |

A paired sample t-test was conducted to explore the impact of the learning process on students' attitudes and beliefs about environmental problems (see Table 4.21). Scoring was completed following the *Global Warming's Six Americas screening tools: Survey instruments; instructions for coding and data treatment; and statistical program scripts* (Maibach et al., 2011). The descriptive statistics and graphs including Q-Q plot proved that the assumptions of normality for t-test data were met for pre-test, post-test scores, and mean differences. The paired sample t-test compared the pre and post test scores $t(16) = 6.7973$, $p = 2.143e-06$. The p-value ($2.143e-06$) was much smaller than $\alpha = .05$, so the null hypothesis ($H_0: \mu_d = 0$) was rejected and it was concluded that the post test scores of the students did increase significantly from the initial application of the survey at the beginning of the instructional intervention ($H_0: \mu_d > 0$). There was a significant difference in the scores for pre-test ($\mu = 40.24$, $sd = 4.87$) and post-test ($\mu = 49.88$, $sd = 4.73$) conditions; $t(16) = 6.7973$, $p = 2.143e-06$. The difference was statistically significant, and it was estimated that the true difference to be at least 7.169212 on the scale. In addition, $d = 1.648585$ was estimated. The effect size ($d = 1.648585$) estimated a 1.64 standard deviation difference between the pre-test and the post-test or that the mean for the post test scores was 1.64 standard deviations greater than the mean for the pre-test scores. According to Cohen's standards, this represented a very large effect size (Cohen, 1988). Thus, there was a strong relationship between the mean of the survey scores and whether or not the score came from pre- or post-test. In conclusion, these results suggested that the instructional intervention significantly affected students' scores on the Six Americas Survey.

Table 4.21. Paired sample t-test results

| | Mean (μ) | Standard Deviation (sd) | P-value | Effect Size (d) |
|-----------|----------------|-------------------------|-----------|-----------------|
| Pre-test | 40.24 | 4.87 | 4.287e-06 | 1.648585 |
| Post-test | 49.88 | 4.73 | | |

As the students’ pre- and post-survey results were compared with the data of the US adult population provided by the designers of the survey, it was observed that the students fell under a narrower range based on both pre- and post-test results (see Figure 4.2). The six audience segments represent a spectrum of concern and action about global warming based on the US adult population, ranging from *Alarmed* (18% of the population), to *Concerned* (33%), *Cautious* (19%), *Disengaged* (12%), *Doubtful* (11%) and *Dismissive* (7%). The pre-test results indicated that these segments ranged from *Concerned* (29.41%), to *Cautious* (41.18%), *Disengaged* (17.65%), and *Doubtful* (11.76%). On the other hand, the post-test results which provided evidence for a significant increase on students’ beliefs and attitudes about environmental problems showed that the segments ranged from *Alarmed* (11.76%), to *Concerned* (64.70%), *Cautious* (11.76%), and *Disengaged* (11.76%).

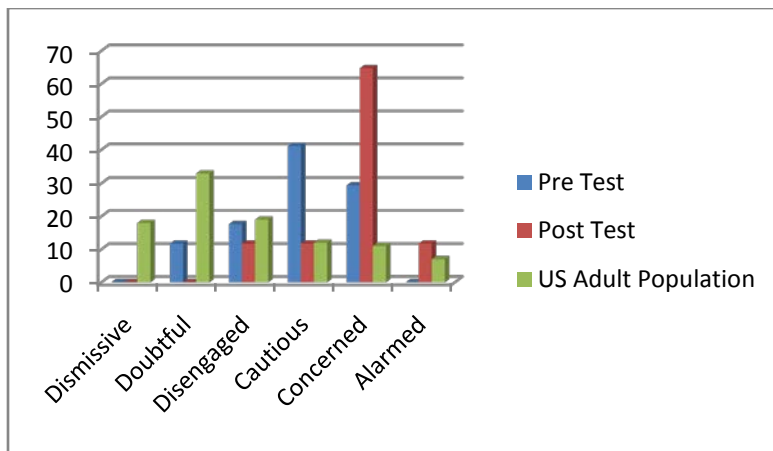


Figure 4.2. The comparison of pre and post test results of the students and US adult population

Qualitative Data

Pre- and post-writing prompts. At the beginning and the end of the quarter, students were asked to provide a written response to the following questions: “Why do we need to care about the environment?” and “How (in what ways) can we protect it?” Pre- and post-responses of the students were analyzed qualitatively to see if there was any improvement on students’ ability of expressing their environmental awareness and activism.

Pre- and post-writing prompt analysis provided evidence for an improvement on students’ ability to express environmental awareness and activism adequately. The graph (see Figure 4.3) shows how many codes related to environmental awareness and environmental activism their writing prompts included.

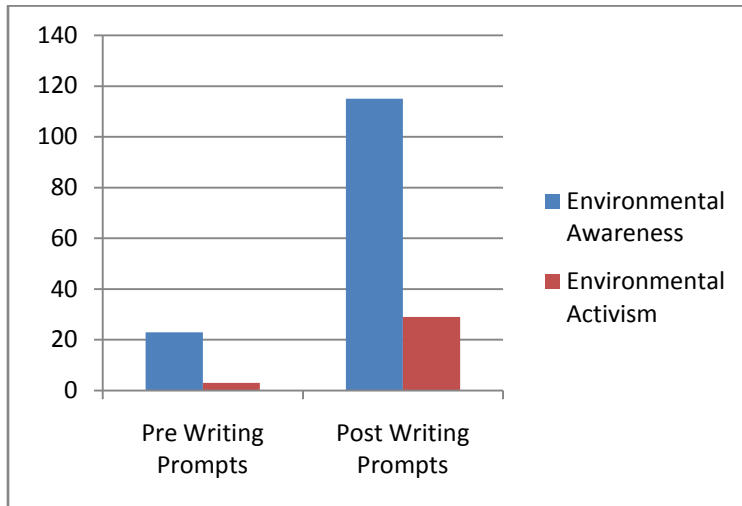


Figure 4.3. The comparison chart of the codes in students’ pre- and post-writing prompts

Pre-writing prompts. Pre-writing prompts showed that the students had inadequate knowledge to show environmental awareness and activism before the instructional intervention. They usually used ambiguous statements without any scientific support. When the students were asked to answer the writing prompt questions before the

instructional intervention, their responses were observed and detailed in the following discussion.

The statements below showed that students considered the fact that they live in the environment as the only reason to care about it. Also, they did not provide any additional information to support or advocate their ideas.

Student 11: We need to care for the environment for many different reason but most importantly because we live here. Its up to us to take care of the environment we live in.

Student 16: We have to care about the environment because we live in it...Just imagine your house being messy, you wouldn't like that.

Student 9: if you have to live here why would u want to live in a durty place like keep it up and make it clean for you and family plus the cumnty.

Student 2: we need to take care the environment because it is where we live in.

In the pre-writing prompts, pollution was the main environmental issue considered by the students (see quotes below). However, they did not clarify what kind of pollution they mentioned in their pre-writing prompts. They mostly used the word dirty to describe the results of environmental pollution. The students did not mention any other kind of environmental issues in their pre-writing prompts.

Student 13: If people were to throw trash everywhere in the park and no one cleans up after it, the park will get so dirty and stinky; then no one would want to go to that park anymore. That is why we need to take care of what is around us because if we don't everything will turn bad and when it turn bad we could loses many things.

Student 21: If we do not care about the environment it could become a dirty place

Student 16: if we don't care about it the world would be a mess, polluted and maybe we wont have any where else to go.

Student 14: if the environment is dirty or unhealthy

Student 2: when we throw waste/ garbage and pollute the environment then we have to all live in the polluted envirnoment.

Considering the effects of the environmental issues, students mostly talked about the effects on nature, particularly on animals. Some of the students specifically used the term habitat to state what the environmental problems affect (see quotes below).

Although they introduced the fact that they live in the environment as the reason to care about the environment, they were not able to make connections between these statements and the effects of environmental issues on humans or society.

Student 21: The environment could also be polluted and animals could die because of all dirty environment.

Student 19: We need to care about the environment. We need to because if we don't it will begin to to take a toll on the world. The habitats will begin to change. The animals and creatures will have to either move or adapt.

Student 12: Without the enviornment, the animals, trees/plants you or evwn me wouldn't be here.

Student 11: if we don't take care of the environment, it can effect animals living in it. For example, throwing garbage/waste in sewers goes straight to the river. The polluted waters affect the fish living there.

Student 4: Those things don't only affect us but it also affect other habitats and animals all over the world.

Student 2: we need to take care the environment because we live in it and so do animals and plant and if we dont then the animals and plants will end up also payin the price.

In terms of pre-writing prompts, the students did not express environmental activism except for a couple of examples. They also used ambiguous messages in these examples instead of giving concrete suggestions. Even though few of them mentioned the need for taking action (see quotes below), these statements did not involve any clarification.

Student 16: Just imagine your house being messy, you wouldn't like that. Lets make a difference.

Student 11: We need to care for the environment for many different reason but most importantly because we live here. Its up to you to take care of the environment we live in.

Post-writing prompts. The last week of the quarter, the students were asked to respond to the same writing prompts. Post-writing prompt data showed that not only environmental awareness and activism of the students, but also their understanding of environmental issues were improved during the instructional intervention. In the post-writing prompts, students expressed their environmental awareness and activism at different levels such as individual, school and community, national, and global. Some students supported their arguments with scientific explanations. Moreover, most students used specific examples and points instead of using statements that are too broad. Each of the major themes is discussed with example quotes in the following section.

Environmental Awareness.

Causes of Environmental Issues. The first theme emerging after the qualitative analysis of post-writing prompts was the causes of environmental issues. The data showed that the students' environmental awareness in terms of the causes of environmental issues was mainly located at the individual and school/community level.

At the individual level, students' statements on the causes of environmental issues showed some variation. Some students stated water and energy waste as one of the main causes of environmental problems. They gave specific examples from their lives to support their ideas.

Student 21: About 95% of water that enter our homes is going down the drain. And, I use water a lot. Energy that are used every day for nothing such as leaving the TV on when no one is watching is wasting energy.

Student 11: Another way is when two people have seprate sinks, that wastes alot of water. Leaving the water running while brushing your teeth and doing other thing is also another way we waste water. Even by flushing the toliet too many

times messes it up. Also, turning/leaving on all the lights in the house, that wastes a lot of energy.

Car use was also present in students' responses as one of the causes of environmental problems at the individual level. Students argued that air pollution and CO₂ increase in the atmosphere is the reason why driving cars causes environmental problems.

Student 19: We drive ridiculous gas using cars that pollute the air.

Student 18: We have done very little to keep it the way it should be, we have polluted the air with our car gases, and CO₂ which is causing our world to not respond in a good way.

Student 17: We are polluting our air by driving our cars and letting out too much carbon dioxide gases which is also a big problem to our global warming.

The last cause of environmental problems mentioned by students in their writing prompts was wasting different materials and/or not recycling these materials. They stated that the fact that most people do not recycle causes environmental problems.

Student 19: Most of us don't recycle when it's not hard to do. We waste so many things.

Student 4: People use plastic bottles, cans, goods and paper everyday and most do not recycle.

Although most students showed environmental awareness at the individual level under the theme of *causes of environmental issues*, some of them touched upon the causes at the school or community level. However, students' awareness in terms of causes of environmental issues at the school and community level was not as frequent as individual level responses in their post-writing prompts. In terms of the negative effects of their community on the environment, they acknowledged not only the members but also the businesses of the area they live in. On the other hand, they used very specific examples such as wasting paper or not turning off the smart board to state the effects of their own school on the environment.

Student 3: In the area I live, the environment gets destroyed by the people living there or by the businesses surrounding it. For example, it can get destroyed by the people if the people throw their trash on the ground, spit on the ground, smoke toxic products outside, waste paper, etc, etc. Businesses destroys the enviornment by their pollution of their machines and other chemmicals they use and need to do their business. This maybe something they cant completely control but their is somethings we can do.

Student 12: At my high school we waist a lot of paper, by printing many things off and sometimes don't use them.

Effects of Environmental Issues. Another theme that emerged from students' post-writing prompts was the effects of environmental issues. This theme appeared in students' responses in two different ways: recent and future effects. In addition to the levels of individual, school and community, national, and global also found in the first theme, effects of environmental issues on nature also appeared in both the subcategories of recent and future. In terms of the effects of environmental problems, unlike the theme of causes of environmental issues, students mostly showed awareness on bigger scales, such as national and global.

In post-writing prompts, students rarely stated the recent effects of environmental issues at individual, school/community, and national levels. On the other hand, students' post-writing prompts included a variety of statements that emphasize the global effects of environmental issues and the effects of environmental problems on nature. Some of the statements that students noted as the recent effects of environmental problems at individual, school/community, and national levels in their post-writing prompts were as follows:

Students stated that the environmental issues such as global warming and climate change have effects on food sources, which results with the health problems for individuals.

Student 4: Global Warming and climate change affects our food a lot that we sometimes get sick or even die from eating most foods.

They sometimes specifically mentioned the recent effects on the communities of these students. Even though they were aware of these effects, they did not point out any specific effect or result on these communities.

Student 8: Climate change can be very harmful to the environment and the communities we live in. When climate change happen most of the time its effects the environment. Those effect left a big impact on the environment and the society we are in.

Students' statements about the recent effects of environmental issues sometimes involved particular areas in the country where they live. They were able to give specific cases in these examples.

Student 12: Places in Texas were facing a drought. They were actually facing a shortage in water.

Students often stated that the environmental issues have negative effects on natural life including animals and plants, mainly focusing on the issues that affect different habitats where animals and plants live.

Student 17: We need water to grow crops (vegetables,fruits), animals need water we need water in order to make our food. Using too much electricity is making the world warmer which makes the arctic to melt! Thats home to many animals like polar bears or penguins, we are destroying their habitat conditions.

Student 3: Forests are being destroyed to make more and more paper, when they paper we already have is not even being used or can be reused. This is important because our innocent animals depends on trees and the green grass, and the forests to survive and feed their families.

Student 2: climate change and global warming is already happening because of us humans and it is affecting plants, animals.

Additionally, students showed awareness in terms of the recent effects of environmental problems on a global scale. Students were sometimes able to give specific examples from different parts of the world. They mentioned a variety of effects on

different countries including natural disasters, diseases, drought etc. Many of them specifically emphasized the recent effects of climate change or global warming on either different countries or the whole world.

Student 20: water is important too plenty of countries and states are suffering from droughts.

Student 17: Using too much electricity is making the world warmer which makes the arctic to melt!

Student 12: Global warming is nothing to mess with. Many countries are already facing global warming.

Student 8: The environment and the people in Japan, Bangladesh, Vietnam, Haiti, India, and China are some of the countries that experience these natural disaster.

Student 5: Already the world is encountering disasters such as food and water shortage because of climate change.

Student 4: There are to many unknown diseases that people are coming up with, and some people are dying from them all around the world.

Students also stated the potential effects of environmental problems expected to occur in the future. Unlike the recent effects, students mentioned the future effects of environmental problems at all levels except national. However, the emphasis was still on the global effects and the effects on nature more than others.

When students talked about the future effects of environmental issues on individuals, health problems were the only effect they mentioned in their post-writing prompts. They connected the effects on nature such as pollution and how these effects cause health problems that can be experienced by individuals.

Student 2: if we dont treat this environment like we should then wont be healthy.

Student 4: If we do not keep our environment clean and pollution free, it would be more likely for humans and animals to get sick. The world if full of germs that are contagious and if it was to be a clean environment that we were living in it would be less likely to catch them. This is important because the viruses and

diseases can be fatal if you don't take precaution. Because of our lack of respect for our environment some animals are having a hard time surviving , which is affecting our food. With the animals being sick , and we need the animals to eat .

Students also mentioned the possible future effects of environmental issues on their community. Even though they were aware of that their community will possibly have trouble due to the environmental problems, they were not able to state any specific problem their community might possibly face.

Student 21: If we do not care about the environment, there will be serious problems that can affect our surroundings.

Student 8: Climate change can be very harmful to the environment and the communities we live in.

In terms of the future effects of environmental problems on a global scale, students usually addressed glacier melting as the main problem. They also believed that there will be catastrophic effects on nature that will result with the extinction of animals and plants. Some believed that environmental problems, especially global warming or climate change, will result in the end of the life on Earth.

Student 2: Temperatures that are too warm will melt parts of the Earth like the glaciers. If the glaciers melt, it will raise the sea level.

Student 15: that goes for the global warming everything will just die there wont be nothing left to live for all the animals will die and just be confused so we have to take care of our environment and help out doing.

Student 20: the environment can get completely destroyed if we dont care.

Ways to Prevent Environmental Issues. The last environmental awareness theme that emerged from students' post-writing prompts was the ways to prevent environmental issues. Under this theme, students' responses usually pertained to the individual and school/community levels, while national and global levels were less frequent.

In the post-writing prompts, individual efforts to prevent environmental issues emerged in four different categories which are: energy saving, water saving, recycling, and reducing car emission. These categories were also observed under the causes of environmental issues. Most students used at least two of these categories in their post-writing prompts instead of focusing on only one particular category. In addition, they usually used their own experiences as examples to illustrate their statements.

The first way to prevent environmental problems at the individual level that students underlined in their post-writing prompts was energy saving. Students offered different ways to save energy. Turning off the lights and other electronic devices when they are not in use was the most commonly stated way to save energy. In addition, some students emphasized the importance of using energy efficient light bulbs.

Student 11: Ways we can prevent this is after leaving a room in your house, turn the light off. Also you can buy energy saving light bulbs. Even though they're more expensive, they shine brighter and last longer.

Student 21: We can save energy by turning off lights that are not needed. We can also unplug cell phone chargers to save energy. Also changing your light bulbs can help.

Student 12: Turning off the lights would also be a great start to saving the environment. Wasting lights is wasting energy for the world.

Student 7: One way that I can care for the environment and need to work on is saving electricity, things that I can do is turning off the light when I leave the room, turning the light off when I'm not using a room, also at night when I'm done watching T.V make sure I turn it off before I go to bed.

Student 3: we need to stop wasting electricity as well as getting rid of pollution. To do that we can make sure that when we are not in the room we turn the lights out, and unplug the electronics from the sockets when they are not being used. when you go to sleep make sure that all the lights are off including lamps and stove lightings.

Students also underlined the importance of saving water to prevent environmental problems at the individual level.

Student 21: We can also help the environment by using less water. Turning off tap water when we are washing the dishes, and when we are brushing our teeth. Also take short showers.

Student 17: To help our world become a better place there are easy solutions, turn off the water faucet when your are brushing your teeth, take short showers, dont take an 1 hour!

Student 16: Use water wisely and don't let the water run without use.

Student 18: Saving water and limiting the water usage in your household will help with our decreasing environment risks.

The third way to prevent environmental issues at the individual level offered by the students in their post-writing prompts was recycling. In this category, students also mentioned reusing materials such as glass, paper, and aluminum.

Student 19: We can stop climate change by recycling. Put the plastic with the plastic, glass with the glass and paper with the paper and aluminum with aluminum. Reuse things like the glass.

Student 17: Recycle paper and plastic. Pick up trash or after yourselves.

Student 20: A few things we can do to help the world is recycle. Recycling helps the ground be clean and not look so yucky.

Lastly, reducing car use was one of the main ways to prevent environmental problems in students' post-writing prompts. They offered carpooling, public transportation, walking, and biking as alternative ways to reduce driving cars. Some of them also mentioned the advantages of using the alternatives of driving in terms of health and economy.

Student 21: We can stop air pollution from cars and trucks by driving less, and taking a different transportation instead of taking your own car.

Student 19: We need to carpool or use public transportation instead of driving your own car all the time.

Student 17: We need to stop driving short distances and walk or bike. Dont drive to nearest store, take a walk!

Student 12: Ways that we can care about the enviornment first, stop using all those fossil fuels. If people would walk, ride bikes, and other non gas drinking things more then the enviornment would be in good shape just by doing that.

Student 5: We need to think about our environment when we go grocery shopping, when we go to a friend's house because of the gas emissions that our cars' are emitting back into the very air that we breath. Instead of using two cars, use one or even catch the bus/ride a bike.

Student 3: Also to better the environment we could stop driving cars so much, like if their was something we needed thats not too far away, why not walk instead of jumping in a car and puching on the gas.

Students were also able to state ways to prevent environmental issues at the school and community level. Some students addressed buying local products that reduces carbon food print to help with preventing environmental issues. At the school level, students mainly talked about reusing papers and turning of the electronic devices in their classroom.

Student 14: If farmers start growing more organic fruits and vegetable in here then this would help by cuttig down on the fossil fuels.

Student 4: At my high school we waist a lot of paper , by printing many things off and sometimes don't use them I think that we could use leftover paper for scratch paper. We could also use both sides of the papers.

Student 21: We can do something to help our surroundings. Buying organic food at the farmers market can also help.

At the national and global levels, students were only able to make general statements as compared to the detailed responses related to the individual and community levels.

Student 12: We as a country need to stop adding carbon dioxide to the atmosphere.

Student 12: Make more energy efficant lights cars.

Environmental Activism. In post-writing prompts, students were able to express environmental activism far more than their pre writing prompts. They usually offered ways to inform others about environmental issues. In addition, they sometimes used short messages in their narratives. Although students expressed environmental awareness at all

levels, they usually expressed their environmental activism at individual and school/community level. The weakest level was global in which students could not really attempt to reflect activism.

The individual level was the strongest level at which students expressed environmental activism in many different ways. They usually mentioned taking action and informing others including friends, family, teachers, and the members of their community. They sometimes used sentences where they addressed their audience directly. Some of the students made statements to encourage their audience for taking actions in favor of the environment.

Student 7: if you can start doing these simple thing, you can help your environment and make a big difference. Also telling your friends and family would help out your environment even more.

Student 3: EVERYONE needs to be curious to the environment and take action, everyone can and should make a change.

Student 16: We have to take care of it like its our last world to live in because we want to live in a safe world. If we don't care about our environment we can lose our world. Help spread the words and teach a friend about global warming and climate change.

At the school and community level, students considered acting as a school. They sometimes stated that they can inform others or take particular actions as a school. Helping their community and doing volunteer work as a school were some of the examples observed in students' post-writing prompts.

Student 20: my friends and I can volunteer to clean up parks and schools. we can donate things to churches and shelters. we can inform other people by annoucements and posters.

Student 7: One way that the community can care for the environment for example at school we can create an after school activity for picking trash up around the neighborhood or even enforce recycling more around the school.

Students' environmental activism at the national level was not as strong as smaller scales such as individual and school/community levels. However, there were still some statements under this category that show students' ability of expressing environmental activism at national level.

Student 19: We can inform people about recycling by creating commercials, billboards on the highway. Offer recycling for free. Not everyone has money to recycle. I think if they our country offered it for free more people will actually do it. Recycling companies in the end will make more money letting people recycling for free.

Student 12: We as a country let citizens know to stop adding carbon dioxide to the atmosphere.

At the global level, students were not fully able to express social activism, except one example. In this example, the student underlined the necessity of encouraging others to show effort in favor of protecting environment.

Student 5: For generations and generations after us we need to preserve our planet. What are they going to do if we destroy this home? Trust me living on another planet is not an option in this century or the next one. If we do not encourage humans for a healthy planet what are we going to do once our food and water really does run out? There really is going to be a war and that war is going to be within the human race.

Student video projects. During the constructionist learning process, students designed video projects that reflected their environmental awareness and activism. These video projects were analyzed qualitatively based on the tree structure of nodes. Students' video projects provided a unique opportunity to see their ability to express environmental awareness and activism.

Four video projects, each of which was designed by a group of four students, were analyzed. The primary topics of these video projects were different perspectives about global warming, reducing car use, saving water and energy, and encouraging for

reusing/recycling. The analyses of video projects were provided via screen captures and transcripts.

The first video project designed by the students focused on showing the teachers' perspectives related to global warming. The students interviewed five different teachers whose teaching areas were not only science but other areas such as social studies, English, and Art. The interview questions that lead the discussion were *what is one way that global warming affects you personally, what is one way you can help to stop global warming, and do you think that you are contributing to global warming?* During the testing phase of the constructionist design process, students in this group realized that their teachers had three different perspectives. The first believed that global warming exists, whereas the second was not really convinced about the existence of global warming. The third believed that regardless of whether global warming exists or not individuals need to take actions in favor of protecting environment. The students showed one example from each perspective in their video projects. When students used written texts, they tried to speak to their audience instead of giving information (see Figure 4.4).



Figure 4.4. The opening scene of the first video project

In the first part of their video, students tried to show the perspective of the teacher who believed that global warming exists. The first question was asked to reflect the

effects of a particular environmental problem on individuals. When the students asked their teacher to identify one way that global warming affected him personally is, the teacher talked about how changing climate and extreme weather events had affected his outdoor activities.

Student: What is one way that global warming has affected you personally?

Interviewee 1: Personally?

Student: Yeah, personally of course.

Interviewee 1: It seems to me weather seems a lot more crazy. Not necessarily warmer but it feels like we have snow storms a lot bigger. Windstorms are a lot bigger. Everything feels bigger. It has affected our camping stuff like this with my kids. The outdoor activities. Really crazy spring of course.

The following part of this video sought an answer for the ways to prevent environmental issues on individual level. After students' question, the teacher gave specific actions he had taken to stop global warming such as reducing car use and plastic bag use.

Student: What is one way you can help stop global warming?

Interviewee 1: When it gets warmer up, I often generally ride my bike to work. My wife rides her bike everyday. So, we are trying drive less. We are generally trying to not to take a lot of packaging. We really do. So, we are not using a lot of oil and plastic. That kind of things.

The last question for this particular teacher was whether he thought he was contributing global warming or not. Teacher did not consider himself as a contributor of global warming.

Student: Do you think that you are contributing to global warming?

Interviewee 1: I don't think so.

In the second part of the video, students aimed to show the perspective of a person who had not convinced that global warming is really occurring. They introduced the opposing argument with the images below (see Figure 4.5).

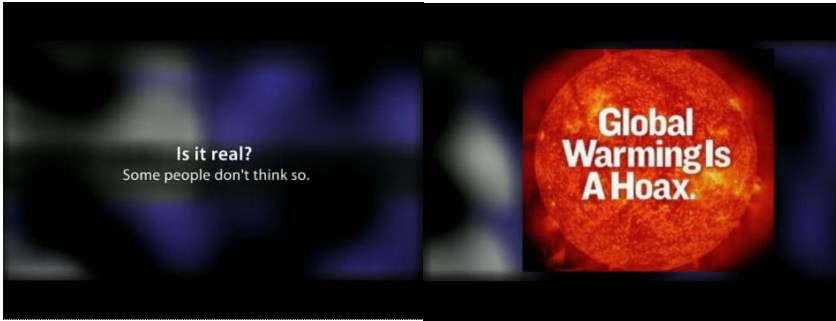


Figure 4.5. The screen used to introduce the second perspective

When students asked their interviewee the first question to talk about global warming, the conversation occurred as follows:

Student: What is one way that global warming has affected you personally?

Interviewee 2: I am not entirely convinced that global warming has been proved.

Students: Ok.

After this response of the second interviewee, the students decided to end the conversation. However, they believed that it was worthy to show this perspective in their project.

The third part of the video showed the perspective of a person who takes actions in favor of environment regardless of whether s/he believes global warming exists or not. When the students asked the first question about the effects of global warming on an individual, the interviewee stated that although there were some recent clues, she was still unsure whether global warming exists or not.

Student: What is one way that global warming has affected you personally?

Interviewee 3: I am still kind of unsure if global warming exists or not. I heard a lot of different views on it. And, I think I am still gathering information about it. I am not really sure if I believe that it exists. Do I like this winter? And then, it is warmer. Yeah.

Student: Ok. I think we are done. We should not even ask the rest of the questions.

Interviewee 3: Oh. Keep going.

The students asked their second interview question to see the interviewee's opinion about the ways to prevent environmental issues on individual level. The interviewee shared the message that everyone is responsible to care about the environment. She also mentioned her carbon footprint, recycling, reusing materials etc. in her response as a way to help mitigating global warming. She specifically stated that she recycles and reuses materials in the school environment.

Student: Ok, well. What is one way you can help stop global warming?

Interviewee 3: I think it is all of our responsibility to be caring about the environment. To do part of that, I try not to put too big our footprint. Not leave too much behind. So, regardless of if I believe whether global warming exists or not, it is real or not, I do feel like recycling is easy thing to do. I try not to waste paper at school as much as I can. If I accidently print something wrong, I try to use the back side. I give scratchpapers to the students. Whatever little things, I can just do. Make sure that I am not leaving a huge footprint.

When the students asked for the perspective of the interviewee about the actions of individuals that contribute global warming, the interviewee expressed that her actions contributed global warming if it is real.

Student: Do you think that you are contributing to global warming?

Interviewee 3: I do think if it does exist.

After the interviews, students tried to interact with their audience by asking their opinions (see Figure 4.6). They mentioned that whether or not global warming exists, there are certain environmental problems, and people need to do something to stop them.

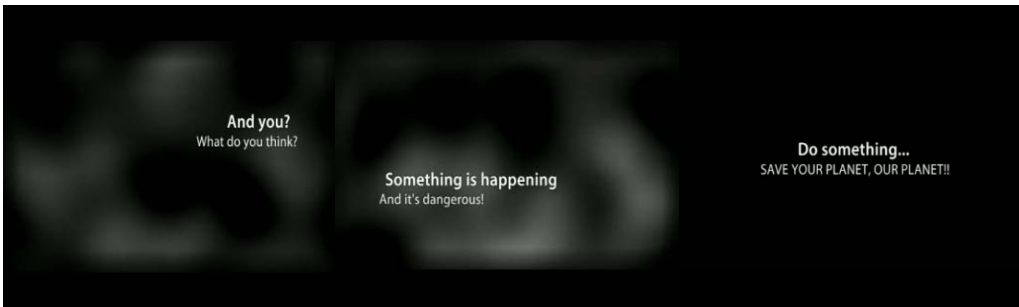


Figure 4.6. Last screen captures of the first video project

In this video project, students expressed environmental awareness and activism by showing different perspectives about global warming. Their interview questions particularly addressed the causes and effects of global warming, and the ways to prevent global warming at the individual level. They first presented the perspective of a person who believed global warming exists and the actions needed to be taken to prevent global warming. In the second part, they showed the perspective of a person who was not really convinced that global warming exists. Lastly, the third interview was to show a point of view that regardless of the controversy, some actions needed to be taken to protect the environment. At the end of the video project, the students tried to interact with their audience and give their messages. In their project, the students presented causes, effects, and ways to prevent a particular environmental issue at the individual and school/community level.

The focus of the second video project was car use and its negative effects on the environment, specifically contributing to global warming. Students used written information, pictures, and videos that they found on the web. They first focused on the US specifically, and then general information about the effects of car use was provided. They focused on the causes of environmental problems at the national level. They also suggested two particular actions to prevent this problem at the individual level.

The video project started with the information about car use in the US and the effects on the CO₂ level in the atmosphere. They first presented general information about the amount of CO₂ released into the air in the US (see Figure 4.7). They used this information to call their audience's attention to the topic.



Figure 4.7. CO₂ emission into the air in the US

After introducing the issue, they connected the amount of CO₂ in the air and the average amount of gasoline used in cars. In this way, they switched their argument from the national to the individual level. They used pictures in addition to the written information to enhance their argument. They first started with the CO₂ emission caused by individual actions. Then, they extended this information on a national scale (see Figure 4.8).



Figure 4.8. Written information provided in the video

After giving introductory information about the relationship between CO₂ increase in the atmosphere and gasoline use in cars, they introduced the video of a scientist (see Figure 4.9). The scientist explains the causes and effects of CO₂ emission into the atmosphere and the possible scenarios next generations may face. In this part of

the video, information about both recent and future effects of car use on a global scale was the emphasis.



Figure 4.9. A scientist explaining the effects of car use on the atmosphere

Considering the audience, the video of this scientist was chosen based on the appropriateness of its academic level. Also, the video was enhanced with animations that made it easier to understand (see Figure 4.10).



Figure 4.10. The animation part of the scientist's video

After the video of the scientist who warned the audience about the causes and effects of the high levels of CO₂ in the atmosphere, students presented ways to reduce car use via texts and pictures (see Figure 4.11). They mainly focused on two solutions which were using public transportation and carpooling. While offering these solutions, they used pictures and poster images.



Figure 4.11. Two ways to reduce car use suggested in the video project

After giving information about car use in the US, global effects of it, and two ways to reduce car use, students gave a short message at the end of the video project. They strengthened their messages with the posters designed by international environmental organizations (see Figure 4.12).

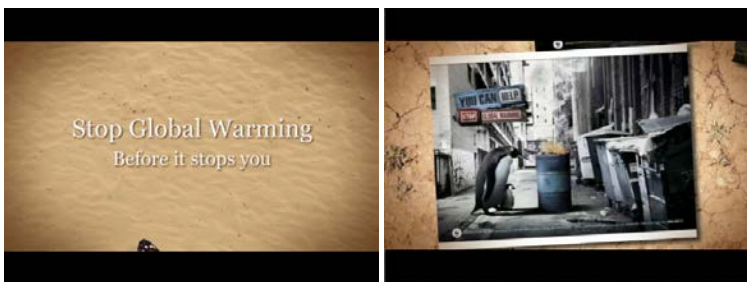


Figure 4.12. Students' message at the end of their video

In this video project, students in this group aimed to provide scientific information about the necessity of reducing car use. They first introduced the problem by presenting national statistics related to gasoline use and its effects on the CO₂ level in the atmosphere. Then, the talk of a climate scientist was integrated into the video with some additional animations. After providing enough information about car use and CO₂ level in the atmosphere, they suggested two ways to reduce car use which were public transportation and carpooling. Last, they presented their end message with texts and posters.

The video project designed by the third group combined two different topics which were water and energy use. The video started with information about saving energy, while the second part of the video was about saving water. As the background music, the students in this group preferred to use a rap song written to encourage others to save energy. They mainly used sequences of images to advocate their argument. They sometimes integrated texts to make their project more informative. They also used a water saving video which was titled “how to save water in six easy ways”. Although students provided some information about the causes and effects of wasting energy and water, the main focus of the video was ways to save water and energy at the individual level. The goal of this video project was to show the effectiveness, importance, and ease of saving energy and water.

In the first part of the video project, students showed the results of energy waste and the ways to save energy. They sometimes used graphs and charts to inform their audience. They first showed why saving energy is so important for the world. They used information found from different resources (see Figure 4.13).



Figure 4.13. A result of wasting energy

They also touched upon ways to prevent energy waste at the school level. They used a tree map that showed tips for saving energy in school (see Figure 4.14). They also underlined the importance of turning off lights in their classroom if not in use.

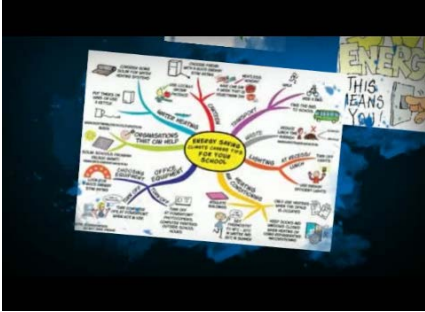


Figure 4.14. Energy saving tips in the school environment

The energy saving part of the video also included some ways to stop wasting energy such as using energy efficient light bulbs and efficient energy transmission and distribution (see Figure 4.15). In this part, they specifically addressed the individual efforts to save energy.

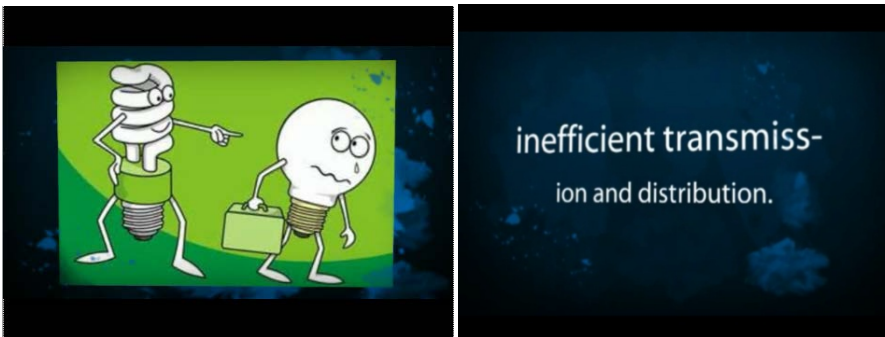


Figure 4.15. Using energy efficient light bulbs

The second part of this video project focused on saving water. In addition to images and texts, students used an informative video that showed how to save water in different ways. At the beginning of this part, they gave information about the water problems on a global scale (see Figure 4.16). They made connections between global problems and how to solve these problems with water saving actions individuals can take.



Figure 4.16. Global water issue

The goal of this video project was to inform people about water and energy waste, its global effects, and the ways to save water and energy. The students in this group presented their argument with many images. They also used statistical information about the global dimensions of the issue. When they presented the ways to reduce water use, they showed an instructional video about how to save water in six ways. They ended their video with the catastrophic effects of water and energy waste on the world.

The last video project was about wasting paper, plastic, and metals, and the importance of recycling them. Instead of showing the ways to recycle, students in this group preferred to emphasize the importance of recycling for the environment. They first showed the amount of paper and plastic bottle waste at the national level (see Figure 4.17). They illustrated the amount of wasted materials by providing real statistics on a national scale.



Figure 4.17. The amount of paper and plastic bottle waste in the US

Although the video project of this group focused on recycling, there were also some additional suggestions about saving water and energy (see Figure 4.18).



Figure 4.18. Saving water and energy in the video

In addition to recycling, students underlined the materials that could be reused, such as plastic bags, clothes, bottles, and furniture (see Figure 4.19).



Figure 4.19. Reusing emphasis in the video

At the end of the video, students encouraged individuals to recycle via images and slogans (see Figure 4.20). They underlined that there are a variety of different ways to recycle.



Figure 4.20. Recycling messages in the video

In the last video project, students tried to make their audience aware of the importance and ease of recycling and reusing materials. They addressed their message via images and videos. They mostly focused on the ways to mitigate environmental problems at a personal level.

Climate change action plan template. The climate change action plan template was an opportunity for students to express their environmental awareness and specifically environmental activism. The document aimed to provide information about students' passion about the issues regarding the impacts of climate change in Minnesota, the change or improvements their school and/or community need to do for climate change, and the connections between their passions and the needs of their school and/or community. The document gave students the chance to reflect on their environmental awareness and activism at the school and community levels, whereas it rarely addressed them at the individual, national, and global levels.

In terms of the causes of environmental issues, there were only a few statements that emerged from students' responses. Except for a couple examples, these statements addressed the individual and school/community levels. In the statements at the individual and school/community level, students noted that wasting energy was one of the causes of climate change.

Student 17: Both of us use excessive electricity and don't preserve energy.

Student 19: Leaving the computers plugged in when we left classroom.

On a bigger scale, there were only two students who mentioned the global scale of the causes of environmental problems. They particularly pointed out air pollution as the cause of climate change, global warming, and ozone depletion.

Student 21: I am most passionate about the pollution in the air because it is making the ozone layer thinner and causing climate change.

Student 7: air pollution because it is causing global warming and causing our ozone layer to thin which brings the heat of the sun closer to us.

In terms of the both recent and future effects of climate change on individuals, students stated that they are most passionate about health problems. They were particularly concerned about the potential health risks for both themselves and their children.

Student 5: I am most passionate about the health risk to my children, myself and others.

Student 17: My family and I would not want my children in the future to get a disease because of the climate change.

At the school/community, national and global levels, students touched upon neither recent nor future effects of environmental problems. On the other hand, there were still some statements related to the effects of environmental problems on nature, specifically on animals. In these statements, students used the word *extinction* as the result of climate change for animals and other living things.

Student 4: The issue that I am most passionate about regarding the impacts of climate change is the animals. When the climate changes, it affects the animals' habitat. The reason why I am passionate about the animals and climate change is because some animals will extinct ☺

Student 9: Climate change will cause animals and plants extinct.

In this particular document, students expressed environmental awareness at the individual and school/community levels in terms of the ways to prevent environmental issues. However, they did not make any statement related to the ways to mitigate environmental problems on bigger scales such as national or global.

At the individual level, students mostly offered four main ways to protect the environment. They mainly focused on saving energy, saving water, reducing car use, and recycling. They usually made their suggestions with short statements.

Student 21: Unplug wires that are not needed or not use so that it can reduce electricity. recycle paper and bottles.

Student 12: walk to most of the places close to your home or work.

Student 14: We can produce less carbon dioxide by using less energy.

Student 13: less driving for less air pollution.

Student 20: We should turn off the lights that are not being used, we should donate the food and clothes we do not eat or wear.

Student 1: When I go to bathroom in school, I see sometimes the water is open. I turn off.

At the school/community level, students usually suggested saving energy and recycling to prevent environmental issues. They often mentioned the specific issues that they observed within their classroom or school. In their statements, students reflected their disappointment about these issues and tried to create solutions. Many students observed that the lights were turned on during the day in their classroom. They specifically underlined this problem, and tried to create solutions in their responses.

Student 12: A change that I would like to see is if it's sunny outside open the blinds up and turn the lights off. When it is nice outside, don't turn the AC on, open a window. Don't leave computers on when not in use.

Student 7: We can use less electricity during the day.

Student 12: They try to use less light (at times). Turning the lights off on a sunny day.

Student 17: turn off the lights when it is day time and just open the windows.

Student 1: Sensored lights in the school.

Another problem students observed in their classroom was not turning off the electronic devices when they were not in use. Students specifically pointed out the smart board and laptops used during the class.

Student 20: Unplug wires of laptops if they are charged that are not needed or not use so that it can reduce electricity.

Student 12: Turning of the computers and smartboard when they are not in use.

Student 18: Not use electronics at unnecessary times. Also, when smartboard isn't in use, turn off!

Students also underlined the necessity of saving paper and recycling in their school. They believed that they needed to reduce paper use in the school, and recycle the papers that they used.

Student 4: What I want to happen at my school is using and printing less paper. I think that there are many high schools which use too much paper each day.

Student 10: I think as a school, we need to recycle more of our paper and bottles.

Student 12: I see that my school recycles more. But they could start using less paper. Recycle more paper/ use less paper.

Student 15: Recycle paper and bottles not only in science class but in other classes as well.

Student 20: Stop printing paper we do not use. My passion is not to waste paper, my school does too.

Student 5: I want to see my school recycle more

In climate change action plan documents, students mainly expressed environmental activism at the individual and especially school/community levels. They usually emphasized informing and/or encouraging other people about the ways to prevent environmental problems.

At the individual level, students mostly believed that they could inform or encourage other people to take actions in favor of protecting environment. They usually

considered the people from their school environment as their audience to inform and/or encourage. They particularly addressed their teachers as a liaison between themselves and other students in their school.

Student 4: Encourage people to save energy.

Student 7: I think I could motivate people at school to do so to.

Student 9: Informing other folks in the school. My passion is writing short things for school teachers, so I have to see school to be an energy saver place. Because that's what I want to be.

Student 17: I would like to see more students to recycle at my school. we need to place certain things where they belong (e.g. plastic, paper, trash). My passion is to recycle more, I think teachers should encourage students to recycle more instead of throwing everything in the garbage. Talk to teachers to discuss recycling in class.

At the school and community levels, informing and/or encouraging other people was still one of the environmental actions students expressed in their responses. Students offered to achieve this goal in two different ways. One group suggested posting notes and signs all around the school to encourage others to take actions for saving energy or recycling.

Student 15: We use electricity that we do not need. Posting notes by lights to turn lights off if not needed and computer if not being in use. Save energy.

Student 18: Post notes saying "turn off light when leaving room", "turn off when not in use", "recycle"

Student 19: Make signs saying "turn off computer when not using"

Student 17: Post signs around school to encourage students to turn off the lights one day at school, and experience a day without lights.

On the other hand, another group of students considered presenting posters and slideshows as the way to inform a wider range of people. One student in this group specifically expressed that she wanted to inform the community members about global warming.

Student 4: Displaying posters, recruiting members to help recycle paper, glass, and plastic.

Student 10: Have a presentation/slideshow about people experience with pollution and how it is affecting their life.

Student 5: I also want the community to be aware of the global warming. I would like to see fundraisers or just free fairs to talk more about global warming.

Student 7: We could do a project on what population and other things are doing to our world and what were doing to cause it, and what we need to do to prevent it.

Students who expressed environmental activism in their responses also noted that they could conduct projects as a school. They stated that they could take action to protect the environment where both their school and community are.

Student 5: Doing projects to promote “going green” as a class or school. Recycling projects. Growing trees, and building solar panel in school garden.

Student 7: We can start a group that goes around picking up garbage.

Student 20: Pick one day a month when we can clean the classes. Recycle all old work, unused things in the school. One day where we pick up the trash in the community.

Student blog posts. Throughout the learning process, students participated in online discussions, blog posts and reflections, and posted pictures and videos on a social networking website. The blog posts on the social network provided an opportunity to see the ways in which students expressed their environmental awareness and activism in a two-way interaction. The data that emerged from the social network was analyzed based on the tree structure of nodes.

The analysis of students’ blog posts showed that students expressed environmental awareness at a variety of different levels, whereas their environmental activism mainly stayed at individual and global levels. In their blog posts, students were

able to state the causes and effects of environmental problems, and the ways to prevent these environmental problems.

Causes of Environmental Problems. In their blog posts, students addressed causes of environmental problems at all levels excluding school/community. At individual level, students mostly talked about wasting water and energy.

Student 2: the reason that the global warming is happening is cause of the things that humans do and need to change, such as leaving electricity on when you dont need it, using cars and vehicles to go places that are not needed, and leaving water running when it is not needed.

Student 6: There are many reasons why global warming has started to speed up such as using to much electricity and water,

When students commented on the videos posted by their classmates, they sometimes stated, rephrased, or summarized the things they watched on the video. Some of the examples about the causes of environmental problems at the individual level were as follows:

Student 12: The things that I saw were things that I sometimes caught myself doing. All the running water,lights staying on, and all the other wasteful things that I have done

Student 7: Some of the points I put down were about water and how people don't realize how much they waste a day, so some of the cause were leaving the water running when not using,not turning the water completely off, and taking unnessesarly long showers.

On a national scale, students reflected on their perspectives about the fact that that the US would experience the problems that some countries all around the world had due to climate change. They also stated that the reason why they expected it was the high CO₂ production of the US.

Student 17: I think the US will face same kinds of environmental problems like other countries in the future because all the CO₂ we produce, all the water we waste.

Student 2: I think the US will face kind of problems because we (developed countries) are the main source of CO₂ that causes climate change

Student 18: The US will face even bigger problems than Africa or arctic because of CO₂ production. We cannot see any effect yet, but when we will be able to see, it will be too late.

They also mentioned that having too many factories that produce industrial pollution was one of the reasons why the US will face environmental problems in the future.

Student 16: Climate change cause by global warming. There are many reasons why global warming will start to speed up here such as having to many factories and pollution from factories.

Effects of Environmental Issues. In terms of both recent and future effects of environmental problems, students' statements that emerged from their blog posts fell under the national and global levels. On the other hand, there was not any statement that reflected students' awareness of the effects of environmental issues on individuals or their communities.

At a global scale, students were able to give specific examples about the recent effects of climate change in different parts of the world. They explained the effects of environmental problems on society and nature in these countries in their posts. They wrote their statements based on their research on the web and the videos and pictures posted on the social network.

Student 7: The effect of climate change in arctic is happening due to the warmth of the climate and the ice melting. In the arctic, people are already suffering due to climate change. The ice is melting and due to that they are less fishing and also they would lose houses and fish so they would have to make out of the arctic or suffer.

Student 13: I would say people need the ice in order to survive in Arctic regions. They need it in order to catch their food and for every other reason. Global warming caused trouble for the people there.

Student 20: Climate change is causing flooding, in some areas due to the heavy rainfall. The north western part of Bangladesh suffered from a drought. Bangladesh is an example of climate change due to the CO2. Over the years the weather has changed. This change has caused severe flooding. This flooding has caused disasters and deaths.

Student 16: The climate change for Africa is that they have been experiencing drought in their communities. The drought is affecting animals, people, and plants because the animals and people need plants to eat and survive. The plant needs water in order to survive.

Students also noted the recent effects of environmental problems on nature in their posts. In their posts, students addressed drought, water pollution, and glacier melting as the main problems for natural life.

Student 3: Having drought effects the environment including the animals because there were no food or good natural resources for the animals to survive, which killed off many animals.

Student 4: The drought affected the animals in Africa. When there is a drought, there is no animal, when the animals migrate or disappear, there is no food coming in.

Student 5: it also puts gaps into the circle of life. This can effect the animals that have found shelter in the glaciers such as polar bears, seals, and penguins.

Student 7: Because people are not noticing how much water they waste, it's effecting people in other countries that struggle to get clean water and it's also effecting the animals there too.

Students' blog posts also showed students' awareness of the possible effects of environmental problems at the national level. Student acknowledged that the US will face environmental problems in the future because of a variety of reasons. While advocating their argument, they compared the environmental problems of different parts of the world and the potential danger the US will face.

Student 6: The US will have the same problems; because until the problems from the past are not solved, they will always come back and cause more problems. Plus new problems.

Students 14: I think the US will face those problems too, and it will just be a matter of time before this happens to us.

Student 2: I think the US will face kind of problems

Student 17: I think the US will have environmental problems in the future

On the other hand, another group of students believed that inconsistency of weather events in recent years was a clue to the potential environmental problems for the US.

Student 4: I think that we will have the problem because we are in a drought now. There has not been much snow in Minnesota this winter.

Student 16: The same because we did not get as much snow as previous years.

Student 21: I believe the US will face the same kind of environmental problems in the future because of the decrease in snow and rain level this year.

Even though most students mentioned the recent effects of environmental issues at global level, some students also stated that there will possibly be some future effects on different parts of the world.

Student 5: If we don't stop wasting too much electricity the Arctic perhaps melt and we would affect the organisms that live in that area.

Environmental Activism. In terms of expressing environmental activism, students' statements in their blog posts mainly fell under individual and global level. However, there were also some examples at national level.

At the individual level, students' blog posts indicated that students' considered informing other people as the main way to express environmental activism.

Student 18: So many people do not care about the world, and if you ever want to see the sky, then we have to conserve energy and save water and walk, bike instead of drive. We will all have trouble in the future. We have to let the others know!

Student 1: Some people do not care about. They only care about money and job. They should think about others in the world. I know environment problems. I must talk to them.

Students' environmental activism on a national scale was not as strong as individual or global level. However, there were still a few statements under this category.

Student 14: The USA probably won't be as bad as others but people need to start taking action NOW!

At the global level, students showed environmental activism by providing solutions for the effects of environmental issues in the countries they mentioned in their blog posts.

Student 20: Find crops that are suitable for climate change. Do things to help protect homes and people for flooding. we can help plants to survive in bad droughts and gave them new technologies.

Student 18: We can help them plant some plants for the bad droughts and gave them new technologies that can help African people to find food.

Student 2: In the northern areas of the world, people are suffering because of ice melting. They can lose their homes. They will need to migrate southern parts even if they do not want to move. They need help, and we have to help them because we are the cause of their problems.

Student feedbacks about constructionist and social constructivist methods and tools. Students' blog posts also gave them a chance to post feedback related to the social networking website and video designing project. Students mostly stated that both the social network and video design affected their motivation and participation positively.

Students mentioned the advantages of using the social network in a variety of different ways. Some students stated that the reason why they liked using the social network was the similarity of its template to the popular social networks they regularly used in their daily lives.

Student 11: I guess this website is kinda cool though. it reminds me on facebook because you can write on peoples wall, post pictures and like things.

Student 18: I kind of like this website too, because it looks kind of like facebook.

Another point students underlined in their posts was the fact that the website helped them catch up with instruction even if they could not be in the classroom physically at some points in the semester. They also added that they were able to keep track of the assignments and have a chance to complete them anytime.

Student 5: I think that this website; climatechangeproject.ning.com, was great because as some of us are mothers we can't always get to school and this website allows us to access our work from home or where ever there is internet connection. Its also really easy for me to keep track with what I did do already and what I've yet to do.

In addition, students noted that the social networking website gave them a chance to share their knowledge and perspectives. Students were pleased to read other people's responses which they believed promoted their own learning. They also stated that the website gave them a chance to look at the old posts to remember what they had learned.

Student 7: During last quarter we created a profile on the climate change project website. To me using this website was interesting it was interesting because we got to discuss are opinions on the questions we were asked and also got to see other people's responses on the question. I also liked the website because I liked talking about what I learned in class so far, when I had to talk about a certain topic that was asked from the teacher, it helped me refresh my memory about what we learned that week and so I know that I learned something that week.

Student 18: I think this is a good idea. I really like that fact that we use the computers more this semester because it doesn't put so much pressure on us having to write on paper and present in class. Instead we just post what we want to say and our friends and teacher just reads it from the website. We don't have to ask each of our friends to learn what they know. I rather do this in every class than just this one.

Student 9: So I think we should continue to work on the climate change website. I think it would be good for student to write about what they learned in class, so when they can't respond to the question that was asked about a topic we been studying, then the teachers and other students will know if the student didn't understand what has been going on in class. They can help this student with this way.

Student 3: We learn something on the webste then we get the opportunity to disscus what we learned and even blog about it. It doesnt make you feel like your in the class room learning about things you think you will never use in your life

but it makes you feel like you are important and have a say so which you can tell others your opinions on what ever the topic may be.

Student 11: We were introduced to a website that helped us communicate with our friends and teacher which was kind of fun.

Some students also mentioned that using the social network was an enjoyable experience. They thought that the social network was different than their past experiences.

Student 20: i think the climate change website is a good resource. sometimes i feel you guys ask to much of us, but we go to the website and work there in our own pace. It is also fun to see other folk's post and make comments.

Student 3: In my opinion the things we used for the class were quite different from any other class. i never experienced a class based off of any websites but i do have to admit that i like it a lot. We used this climate change website which is kind of fun. at first i thought it was going to be boring and just torture but it teaches you a lot of interesting things about your environment which you should have already known.

Student 15: In the last quarter we started to use the website, and for me its a great thing to have. This climate change website you learn a lot from it. This helps us get better at reading, sharing and comprehending. i would recomend this to anyone because these are real life things that we learn about. I liked learning this technologies.

There were also some English Language Learners (ELLs) in the classroom who were not able to read and write as well and as fast as others. They also noted some benefits of using the social network for them specifically.

Student 1: yes, i like tachnologies because sometime we need to find dictionary by sometime we don't understand the word we look the pictures for find something. we need to go to the website to do. I like to do tachnologies because sometime i watch movie and find climate change. I understand without read a lot.

Even though almost all the statements about the social network were positive, there were a few negative points students mentioned in their posts. They usually pointed out that they did not feel comfortable enough to share what they wrote with others in the class.

Student 5: The only thing I did not like about this website is the fact that other people can see what I wrote. Sometimes I write things in more of a personal matter and everyone can see it; not so confidential after all, eh. Besides that I thought it was great.

In their blog posts, students also wrote their feedback about the constructionist video designing process. Most of the students believed that designing a video project was different and fun. They also mentioned that they were pleased when they watched their end products.

Student 5: The video design project was quite fun when I think about it and it also pushed some of us. the project itself was interesting. Gathering the information, pictures, and sources, was challenging in a way but seeing the final project was great.

Student 11: The video project was kinda cool too. I get to learn how to put it together and I helped gather the information needed. When it was finished, I was proud of myself and my group.

Student 20: the video project was a good idea. i felt we had enough time to finish it as long as you and your partners working hard. we were given the equipment we needed to get the work done.

Student 7: When we first started the video project I thought that it was going to be an easy, fun project that would teach me something new but also was fun. While we started to work on it, it started to get more complicated because some people didn't show. However, we worked very well, and research, find pictures and videos, put them together. Then during class we really work on it and discuss about the project. I really liked when people acclaimed our video after our presentation.

Student 3: In our environmental science class we've used a video designing process which was something i didnt really get a chance to use because I missed too many classes. but as i was watching the videos my classmates put together i wish i could have been around to create one myself.

Students also made comments about the video projects their classmates designed via the social networking website. They reflected on how they were impressed by each other's videos in their comments.

Student 7: In the short movie that you presented yesterday was a big eye opener for me. The things that I saw were things that I sometimes caught myself doing.

All the running water, lights staying on, and all the other wasteful things that I have done. But I can make a stop to that by changing the way I go about things. I could use less water, change my light bulbs to energy efficient lights, start recycling, and just really go green. That short movie yesterday really gave me a different way to look at life.

Group progress reports/Observational field notes. During the five-week constructionist design process, one student from each group wrote group progress reports to reflect what they had done and what they were planning to do in their next steps. In addition, the researcher as participant observer also took observational field notes to record his observations. These two data provided rich descriptions about the progress of the students in the designing phases.

One of the important points that emerged from these two documents was the reasons why students chose the subject of their video projects. While explaining these reasons, students expressed their awareness about the importance of the topics. Each group came up with different reasons that caused them to focus on a particular topic in their video projects.

Group Progress Report- Group 1: We definitely want to show wasting water and energy, because all our families and us waste too much water and energy in our home. Now we can see how much we waste water and energy and how we can stop wasting.

Group Progress Report- Group 2: Our group will interview teachers. They must know global warming more than us. We will ask them questions. Like one way global warming affects them, one way they can stop global warming, if they contribute global warming. We believed they will give good information to us and other students.

Group Progress Report- Group 3: our school waste too much paper. we always print something we donot use. So, we want to talk about recycling in our video. 3R-Recycle, Reuse, Rethink. Not all classes has recycling box.

Group Progress Report- Group 4: the reason why we show driving car in our video is CO2. We put too much CO2 in the atmosphere. We need to stop. We like biking. Everyone should bike. Everyone say they like biking and anyone don't use bikes. People only talks. They never take actions.

In the group progress reports, students also expressed environmental activism. They mostly stated that they were willing to share their video projects with others in their school and their community. That is why, while designing their videos, they kept thinking about their audience and how they could address their interests.

Group Progress Report- Group 1: I want use my brother in this video. I'm not sure he accept but if he do not accept, I want to show it to him. He can learn to save energy and water. i think all of us should show our videos to our families. They can be proud of us. Then they can learn saving water and energy. They could find these informations on internet, but if they see our video, they can watch more seriously and carefully.

Group Progress Report- Group 2: we want to show our video to other folks in our school. we interviewed our teachers and other students can listen our teachers. If we talked in our video, it would not be so much effective. I think we definitely have them watch our video. They can learn something from our teachers outside of the classroom.

Group Progress Report- Group 3: Maybe, we can help our school to recycle. We can show it in our video, and we can put recycling paper boxes all around our school.

Another important point that emerged from the group progress reports and observational field notes was the positive effects of video designing processes on students' motivation and participation in the class. While working on designing their video projects, most of the students participated in the cooperative work. Even if some students did not care what was happening in the class during the regular class hours, they participated in the designing processes.

Observational Field Note 3: This week, students were working on finding materials for their videos. Student 21 was not really interested in the class for a while, but when her group was trying to find a song for their video, she jumped into the discussion and asked them to take responsibility. While thinking about what song she could use in the video, she checked all the images and videos her friends had found. Then, she uploaded a song from her mp3 player to use in the video.

Group Progress Reports- Group 1: while making our video, all of us share the responsibility. Two of us foind information. Other two found photos and videos.

And, student 17 worked on animoto, organize our video. I think all of us did a very good job.

Group Progress Reports- Group 2: we worked on our video pretty good. All girls except Student 5 worked very good. Each of girls did something. Student 5 have problems. thats why she cannot help us, but others worked very weell when they are in classroom.

Analysis of qualitative data. After the analysis of qualitative data sources, certain themes became apparent. Based on these themes, a tree organization of nodes and some free nodes were created (See Figure 4.21). Considering the first three research questions, student awareness and student activism were assigned as parent nodes (shown in maroon rectangles in Figure 4.21). Each of these themes was specifically investigated at personal/individual, school and community, national, and global levels. The subthemes which are causes of environmental issues, effects of environmental issues, and ways to prevent environmental issues (shown in blue squares in Figure 4.21) were emerged under the theme of environmental awareness. After the analysis of students' responses that reflected students' feedback about the methods and tools employed in this study, free nodes such as student motivation and student engagement under impacts of constructionist and social constructivist frameworks were created (shown in silver circles in Figure 4.21) to answer the last research question. Also, a new children node was added under the theme of effects of environmental problems corresponding to four main levels. For instance, when students stated the effects of environmental issues, the effects on nature was emerged in addition to the levels of personal/individual, school and community, national, and global. Therefore, this node was located under the theme of effects of environmental issues.

During the analysis of qualitative data, four main levels of students' awareness and activism emerged. These levels were individual/personal level, school/community

level, national level, and global level (shown in yellow rectangles in Figure 4.21). Students' responses were further categorized based on these four levels to see their understanding of environmental problems. The first level indicates actions taken by individuals, whereas school/community level refers to the school and community of the students. National level specifically points out the US and actions taken by this country. Lastly, global level means international scale and/or the world as a whole.

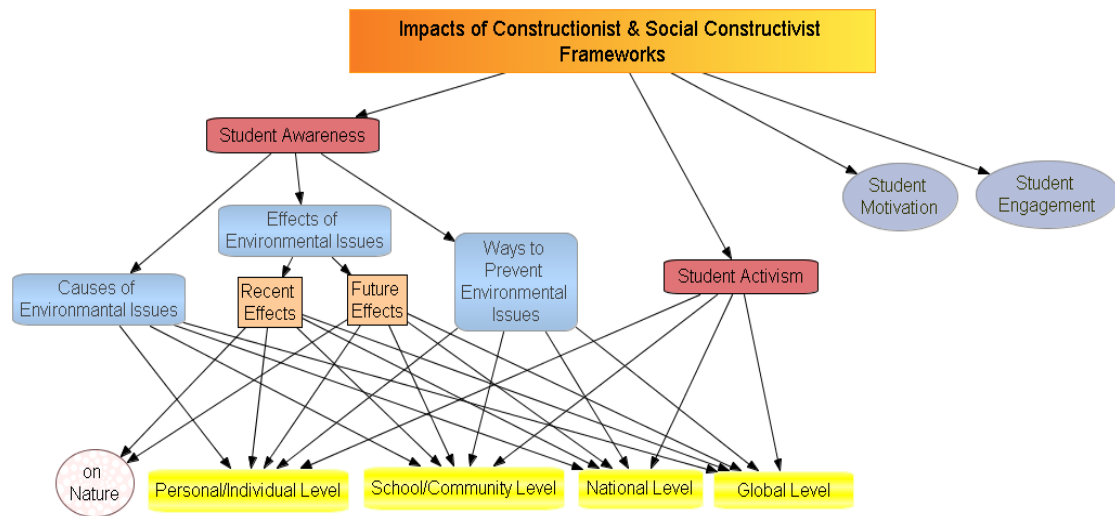


Figure 4.21. The tree organization of the nodes

Summary

In this chapter, the findings that emerged from qualitative and quantitative data sources were shared. For quantitative data findings, a paired-samples t-test was used to see if there was a statistically significant difference between students' pre- and post-responses in the Six Americas Survey. In addition, each question in the survey was investigated deeply by providing descriptive statistics. To analyze qualitative data, the tree structure of nodes was used to organize findings. Screen captures of students' video projects and direct quotes from their written responses were shared for reliability

purposes. The next chapter will provide discussion of the findings categorized based on each research question, implications in education field, and potential areas of the future research.

Chapter V: Discussions and Implications

In this chapter, the research questions will be presented with a complementary discussion. The discussion will make explicit connections between the findings that emerged from the analysis of data and how these findings adequately address the research questions. In addition, connections to the existing literature related to this study will be made to enhance research findings. Next, implications for the education field will be discussed. Lastly, the chapter will be concluded by discussing potential areas for future research.

Review of the Study

The purpose of this study was to understand the impacts of constructionist and social constructivist approaches on high school students' environmental awareness and activism. To explore the purpose of the study, constructionist and social constructivist frameworks were employed to teach a nine-week environmental science class. The topic of climate change was used as the context of this study. The data also provided some insights into how the motivation and engagement of students was effected by the frameworks used in this study.

In this study, the social constructivist learning environment was provided via a Ning social networking website. Students created profiles and participated in synchronous and asynchronous online discussions on this website. In addition, students designed videos to reflect their attitudes, beliefs, awareness and activism with regards to environmental problems was implemented. The four main phases of the constructionist design process were followed (Harel, 1991; Kafai, 2005): planning, designing, testing, and sharing.

A mixed method research design was used in this study. The Six Americas Survey provided quantitative evidence for changes in students' environmental awareness and activism, whereas the qualitative data emerged from pre- and post-writing prompts, students' video projects, climate change action plan templates, group progress reports, and students' blog posts on the social networking website. The quantitative data was analyzed via R Project for Statistical Computing version 2.15. Paired-samples t-test was used to see if there was a statistically significant difference between the pre- and post-test responses of students in the Six Americas survey. The qualitative data was analyzed using NVivo qualitative analysis software. After creating a tree organization of nodes in the software, the qualitative data was coded based on this tree organization. Additionally, free nodes related to the motivation and engagement of the students were created.

The detailed findings that emerged from both quantitative and qualitative data were shared in Chapter 4. Table 5.1 summarizes the qualitative and quantitative findings based on the item groups provided in Six Americas Survey analysis.

Table 5.1. Comparison and contrast of the qualitative and quantitative findings

| | <i>Item</i> | Quantitative Findings (post-test) | Qualitative Findings |
|---------------------|---|--|---|
| Belief Items | <i>certainty that global warming is occurring</i> | Most students were extremely or very sure about the occurrence of global warming. There were not any students doubtful about the occurrence of global warming. | All students were convinced about the occurrence of environmental problems. |
| | <i>human causation</i> | Almost 90% of the students believed that global warming was caused mostly by human activities. | Students completely focused on human-induced causes of environmental problems. There was not any statement related to natural influences on environmental problems in any qualitative data sources. |

| | | | |
|--------------------------|--|--|--|
| | <i>personal risk</i> | In post-tests, most students stated that global warming will affect them personally in a great deal or a moderate amount. Others stated that they did not know how much they would be affected. | Students were not fully able to state the current or possible effects of environmental problems on themselves as individuals. They sometimes used ambiguous statements to describe it. |
| | <i>timing of harm to Americans</i> | 64% of the students believed that people in the US were currently being harmed. The rest of the students chose either 10 or 25 years which were relatively short term among the choices. | Even though students stated that the US will be affected by environmental issues in the future, they rarely talked about the effects or specific cases related to environmental problems the US experience recently or in the future. |
| | <i>risk to future generations</i> | 90% of the students believed that future generations would be affected by global warming in a great deal or a moderate amount. This was a lot higher than the percentages for personal risk. | Students mostly stated that future generations would experience environmental problems in a great deal. They believed that the effects of environmental problems will actually be experienced by next generations. |
| | <i>ability of humans to successfully mitigate global warming</i> | None of the students believed that humans can reduce global warming. They mostly stated that people are not willing to change their behaviors, so global warming is not going to be stopped even if it was possible. The percentage of students who chose that global warming will not be stopped increased greatly between pre- and post-tests. | Students usually mentioned worst case scenarios. Not only were they able to state the ways to prevent environmental problems, but they were also willing to take these actions in favor of protecting the environment. However, their disbelief about mitigating environmental problems was obvious. They specifically touched upon the extinction of life or catastrophic environmental disasters all around the world in the future. |
| Issues Involvement Items | <i>worry about global warming</i> | Most of the students were somewhat worried about global warming. There were not any students who were not worried at all. | The qualitative findings indicated that the students were getting more worried about environmental problems in parallel with being aware of these issues. Students stated that they care about environment. They were specifically concerned about natural life, next generations, and people who suffered due to environmental disasters all around the world. |
| | <i>thought given to global warming</i> | Most students chose that they gave some or a little thought to global warming. Although there were some students in pre-test who did not give any thought to global warming at all, these students stated that they gave some thought to global warming in post-test. | Students reflected on that they started to think about environmental problems more while being aware of the causes and effects of these problems, especially the potential effects on their children. They were more concerned about environment at the end. |

| | | | |
|--|--|---|---|
| | <i>personal importance of the issue</i> | Most students stated that global warming was very or somewhat important to them personally. None of the students chose extremely important in either pre- or post-test. | Even though they were aware of the importance of environmental problems for humans, they did not mention the importance of them at personal level. Since they did not directly experience any negative effects, they did not specifically mention the personal importance of these issues. |
| | <i>unwillingness to change opinion</i> | Most of the students were somewhat agree or disagree to change their opinions about global warming. Only a few stated that they strongly disagree to change their opinions. | During the entire process, students had no intention to change their perspective about the occurrence of any environmental problems. They used the examples of environmental disasters to support their argument about the occurrence of climate change and global warming |
| | <i>friends share views on global warming</i> | Number of friends who shared their view on global warming increased between pre- and post-tests. | When they stated their willingness to take actions, they reflected their confidence about acting as a group with their friends. This indirectly indicated that they believed their friends share their view on environmental issues. |
| Behavior Items | <i>punish companies that are not reducing emissions</i> | Most of the students answered this question as they never punished companies that are not reducing emissions or as they did not know. However, there was a slight increase on the amount of times they punished these companies between pre- and post-test responses. | Even though they expressed activism in their writings, it was usually expressed as informing and encouraging others or taking actions to improve environmental standards of their school and/or community. They never mentioned punishing companies that were not reducing emissions. Considering the age of these students, it was not very surprising. |
| Preferred Societal Response Items | <i>Citizens should do more/less to reduce global warming</i> | Almost all students stated that students should do more or much more to reduce global warming. | Students mostly stated that people should do much more to mitigate environmental problems. They were able to specifically list the behaviors of people that caused problems for environment, and what people need to do in favor of protecting the environment. They stated that people did not do anything to protect environment although they were aware of the problems. They also considered the people in the US as the main causes for environmental problems. |
| | <i>priority of global warming for president and Congress</i> | Almost all students believed that global warming should be a high or very high priority for presidential and Congress. | Students never mentioned political actions that needed to be taken to mitigate environmental problems. They mostly stayed on the actions individuals and schools/communities could take. |

| | | | |
|--|---|---|---|
| | <i>contingent international conditions for US mitigation action</i> | US should reduce its greenhouse gas emission regardless of what other countries do increased dramatically between pre- and post-tests. Some students still chose did not know option. | The students usually stated that behavior of people in the developed countries caused environmental problems, but people in the less developed countries suffered because of the effects of these problems. That is why they stated that developed countries should have been the ones who needed to take the first steps to protect environment. |
|--|---|---|---|

Discussion of the findings.

There were four research questions for this study. These questions were:

1. How do constructionist and social constructivist frameworks impact students' environmental awareness?
2. How do constructionist and social constructivist frameworks impact students' environmental activism?
3. How do students express environmental awareness and activism throughout constructionist and social constructivist learning processes?
4. How do constructionist and social constructivist frameworks affect students' motivation and engagement?

In this section, each research question will be discussed through study findings.

Research question #1.

The first research question explored the impact of constructionist and social constructivist frameworks on high school students' environmental awareness. Both quantitative and qualitative data provided evidence for the improvement of students' environmental awareness. The findings showed that there was a statistically significant difference between students' pre-test and post-test scores on the Six Americas Survey. In addition, qualitative data findings demonstrated that at the end of the learning process

students were aware of environmental problems, the causes and effects of these problems and the actions that need to be taken to prevent them. Due to the socio-scientific nature of the instruction and student projects, students' environmental awareness was mainly formed along four themes: occurrence of environmental problems, causes of environmental problems, effects of environmental problems, and ways to mitigate environmental problems.

The Six Americas Survey findings revealed that although there were some students who were doubtful about the occurrence of global warming before the instructional intervention, these students moved to the other segments which indicated their growing awareness of the occurrence of the global warming issue. Even though students were introduced to different perspectives about controversial environmental problems, the Six Americas Survey, and students' writing and artifacts showed that there were no students who did not believe in the occurrence of climate change or global warming at the end of the unit. To further illustrate this point, although a group of students who conducted interviews with the teachers for their video project realized that most of their teachers did not believe global warming was occurring, both the group members and the students who were presented the video project still persisted that global warming was occurring.

When students argued for the occurrence of climate change or global warming in their writing, they usually supported their arguments with the real-world cases of the effects of these environmental issues in different parts of the world instead of scientific information. Students believe that real-world cases provided via media are less complicated and more convincing than scientific information not only for themselves but

also their audience. Even though they had access to both scientific information in text and graph forms and real-world examples in the media, they preferred reflecting on real-world cases in their writing and projects. Thus, their beliefs about the existence of environmental problems were mainly affected by the media that were shared on the social networking website. This finding shows consistency with both Barraza and Walford (2002) and Jinliang et al.'s (2004) studies which emphasized that students' awareness, attitudes and understanding are mainly influenced by media coverage.

Both quantitative and qualitative data analysis showed that students were mostly convinced about the human causation of environmental problems at the end of the instructional unit. Not only was the biggest statistical increase observed in the question that measured students' beliefs about human causation of global warming in the Six Americas Survey between pre- and post-tests, but students also mentioned the human activities, specifically their own behaviors, that caused environmental problems in their post-writing prompts, blog posts, and video projects frequently. Only one student chose that global warming was caused mostly by natural changes in the environment in the post-test, and there were no statements related to natural influences on environmental problems in any qualitative data. These results were consistent with Roth's (1992) description of awareness which particularly emphasized the perception of human/nature interactions and consequences in general or around a particular issue.

The reason for the significant increase in students' awareness related to human-induced causes of environmental problems might be the socio-scientific focus of the instruction that resulted with the emphasis of human-nature relationship and social aspects of environmental problems. Also, while researching the information to use in

their blog posts and video projects, students usually came across the human actions that caused environmental problems. Not only did the resources that address students' needs and interests usually ignore the natural influences on environmental problems, but also most of their content was related to human-induced causes of environmental problems. Even though students rarely came across the information about natural changes and their effects on environmental problems on the web or in the interviews with teachers, they usually ignored this information because they could not integrate these natural influences into the context of their posts and projects. Even though most of the observed global warming — at least 74 % — is almost certainly due to human activity (Huber & Knutti, 2011), natural influences have a role in global warming that cannot be ignored. However, students considered natural influences as indirect evidence of ignorance of climate change/global warming or human-induced causes of environmental issues because of the web sources that used the term natural influences and teacher interviews.

The findings also showed that at the end of the learning process, students were aware of both the recent and potential effects of environmental problems. At the beginning, they believed that the environmental problems would have effects mostly in the future, but their post-survey responses and qualitative data collected at the end provided information that they were aware of both current and potential effects of environmental problems on humans and natural life. When the questions related to the effects of global warming in the Six Americas Survey were investigated, it was observed that students believed the effects of global warming would be observed sooner in the US than stated in the pre-test. Also, although most students at the beginning only believed in the effects of global warming on future generations, their beliefs about the effects on

them personally became apparent in their post-test responses. In terms of the current effects of environmental problems, they mostly mentioned the problems occurring outside of the US, specifically the least developed countries of the world. Even though students in their post-survey responses stated that people in the United States are being harmed now, they addressed the environmental disasters occurring outside of the US whenever they stated the current effects of environmental problems. However, students' beliefs about the potential future effects of environmental problems in the US were still observed in their post-writings, although these statements were mostly ambiguous without any concrete explanation. The analysis of qualitative data sources showed that students were not able to estimate what kinds of effects the US would experience due to the climate change, global warming, or any other environmental issues, although they believed that the US would be affected by these environmental problems ultimately.

The comparison of students' posts on the social network and post-writing prompts showed that the knowledge of students about the environmental problems on the global scale usually derived from the media on the social network. It was another point supported by Barraza and Walford (2002) and Jinliang et al.'s (2004) argument about the effectiveness of media on students' attitudes, awareness, and activism in environmental contexts. Whether they preferred to share the information related to the effects of environmental issues occurring outside of the US or the resources that showed the effects of environmental problems on the US were not as accessible might cause them to focus on the effects of environmental problems outside of the US.

Students' environmental awareness with regards to the actions that need to be taken to prevent environmental problems also showed a significant increase after the

learning process. Students' beliefs about the US government and citizens taking more actions were increased between the pre- and post-test responses in the Six Americas Survey. Also, qualitative data analysis provided information that students believed that people should do much more to mitigate environmental problems. While exploring the ways to prevent environmental problems, they started to criticize the inadequacy of people's efforts. Because of that, their statements usually aimed to show the ease of taking actions in favor of protecting environment in order to motivate others to take these actions.

Students' post-survey results and the qualitative data sources collected at the end of the unit showed that their beliefs that global warming would be stopped declined during the process. Between pre- and post-survey responses, the percentage of students' responses that global warming would not be reduced because people did not take necessary actions in favor of protecting the environment increased dramatically. In their post-writing prompts and blog posts, they also talked about the worst-case scenarios such as the extinction of animals and the end of life on Earth. They usually complained about the lack of care and involvement of people about the environment. Although they were able to provide necessary actions to prevent or stop environmental problems, their disbelief about humans' ability and efforts to mitigate environmental problems was observed in their statements. While obtaining awareness about the behaviors causing environmental problems and actions to prevent these problems, they were probably able to observe these behaviors often but not the actions in favor of protecting the environment in their family, community and popular media, which might cause them to have more pessimistic predictions about the future. However, when students gave their

messages to their audience in their video projects, they reflected a more optimistic perspective to convince their audience to take actions. Students' video projects usually implicitly gave the message that environmental problems would be stopped although their written statements asserted the contrary.

Lastly, it was worthwhile to investigate the differences between the quality and quantity of the statements students made at the beginning and end of the learning process. The fact that they had almost no prior knowledge related to environmental issues before the instructional intervention might have made gains in awareness related to this particular content more evident. Although students had some idea about the necessity of protecting the environment, they were not aware of the behaviors that cause environmental problems, the current and potential effects of these environmental problems, and the actions that need to be taken to mitigate or stop these problems. Their post-writing samples proved that they were not only able to state these behaviors, effects, and actions but also make connections among them to enhance their own understanding and awareness, which indicated the complexity of their understanding in this particular topic.

Research question #2.

The purpose of the second research question was to show the impact of constructionist and social constructivist frameworks on students' environmental activism. The findings provided evidence that students were able to reflect on their environmental activism more strongly at the end of the learning process. By the end of the study, not only were they willing to take the necessary actions in favor of protecting environment individually or as a group, but they were also very motivated to inform other people to

take these actions. However, these actions were usually transmitting their environmental knowledge and attitudes to the people around them such as their family, classmates, or sometimes community members. The Six Americas Survey responses of the students did not indicate an increase in the times they had punished companies that were not reducing emissions between pre- and post-tests. Also, qualitative data rarely showed any attempt to take direct actions such as taking actions against factories causing industrial pollution. Considering the age of the students, this was to be expected.

Students' pre-survey responses, pre-writing prompts, and the blog posts written at the beginning of the learning process showed that although they expressed environmental awareness to a certain extent, they were not able to make statements in terms of environmental activism. However, students' environmental activism increased by the end of the study enough to be reflected in their post-survey responses, post-writing prompts, video projects, and blog posts. Not only were they able to make statements that reflected their environmental activism, but they also showed their willingness and motivation to take actions in terms of environmental activism.

Students' environmental activism was mostly comprised of informing others about environmental issues and motivating them to take the necessary actions in favor of protecting the environment. During the designing process, they transferred their environmental activism to a more concrete form by designing video projects to inform others about environmental problems and publishing these videos on a public website. Although interacting with their audience was not required in their video projects, all groups showed some effort to give their environmental messages to their audience via their videos. In addition to responding to the questions in the survey that addressed their

environmental activism and the post-writing prompts, they also reflected on their activism in their comments, conversations, reports, blog posts, and artifacts even when they were not asked to reflect on activism. It was an important indicator showing that they were able to express their environmental activism not only when they were asked in a question form but also anytime they were participating in a conversation about environmental issues.

Research question #3.

The third research question explored how students expressed environmental awareness and activism throughout the constructionist and social constructivist learning processes. Quantitative and especially qualitative data analysis provided evidence for an improvement in students' ability to express their environmental awareness and activism. The students' environmental awareness and activism emerged at four different levels which were: personal/individual, school and community, national, and global. The study findings showed that students were able to express environmental awareness at personal, school/community, national, and global levels, whereas they mostly expressed their environmental activism at personal and school/community levels.

Students' environmental awareness was formed at different levels. When students mentioned the causes of environmental problems, they mostly addressed the behaviors of individuals. These behaviors mostly emerged from their own experiences at either home or school. Since they were able to see water and energy waste, car use, not recycling/reusing at their home and school, they addressed these points in both their statements and their video projects. On the other hand, they rarely discussed anti-

environmental actions on bigger scales, such as industrial pollution or reduction of greenhouse gas emissions at the government level.

Students' environmental awareness with regards to the actions that need to be taken to prevent environmental problems also showed a significant increase after the learning process. The analysis of data showed that students became aware of the fact that actions needed to be taken by themselves, their school, and their community. When they stated ways to prevent environmental issues, they usually suggested the actions that could be taken at the personal, school, and community levels, although they rarely touched upon the actions that could be taken by governments and national/international organizations. Even though they sometimes gave references to statewide, nationwide or international environmental organizations in their blog posts, they were not fully able to connect them with the contexts of their writing and projects. If students were doubtful about their capability to take or get involved in particular actions, they preferred not to address these actions. Additionally, when students suggested the actions that need to be taken to mitigate environmental problems, their suggestions were usually formed based on the behaviors they mentioned as causes. When they became aware of that a behavior caused environmental problems, they suggested a counter-action in favor of stopping the effects of this behavior. Their awareness about the ways to mitigate environmental problems was improved in parallel with the causes of environmental problems. That is why, their awareness of both the causes of environmental problems and how to mitigate these problems mostly formed in smaller scales such as personal/individual, school, and community levels.

In contrast, when students mentioned the effects of environmental problems, they rarely addressed the effects on themselves, their community or even their country. Even though they were aware that their personal actions caused environmental problems, they were not fully aware of either the recent or future effects of these environmental problems on them personally, their community, or their country. They mostly believed that natural (non-human) life and less developed parts of the world experienced and will experience the effects of environmental issues. Therefore, in terms of the effects of environmental problems, they usually expressed their environmental awareness on bigger scales such as the global level. Even though they were aware of the fact that environmental problems affected the habitats where they lived, they were not able to make connections with how these changes in habitat affect them and their community directly or indirectly.

The data analysis indicated that students usually expressed environmental activism at the school/community level. Even though they made some statements which indicated activism at the personal level, they suggested taking these actions within the school or sometimes in their community. They specifically mentioned the problems they observed in their school, and tried to create solutions for these problems. When students expressed environmental activism, they usually suggested taking actions as a class or school instead of acting as individuals. Additionally, students mostly expressed environmental activism in terms of transmitting their environmental knowledge to other people in their home, school, or community and motivating these people to take actions in favor of mitigating environmental issues. Students expressed that they were willing to change the behaviors of people around them whose actions were causing environmental

problems. In conclusion, environmental activism of students was mostly in smaller scales, personal, school, and community levels.

When the statements indicating students' environmental activism were investigated, it was observed that students usually expressed their environmental activism about the topics they used in their video projects. The information and messages in their video projects were also reflected in their writings. The reason might be the fact that constructionist design process resulted students with focusing on a particular issue in-depth. Since they gained knowledge about a particular focus after the constructionist design phases, they might be able to express their activism on this particular issue more comfortably. Considering the arguments of Tuohino (2003) and Barraza and Walford (2002) that although people are knowledgeable and aware of environmental issues, they are not usually ready to transfer their knowledge and awareness into action, it can be concluded that designing video projects to reflect their activism in a concrete form helped students to obtain necessary skills to transfer their knowledge into the activism form.

Even though originally this study did not aim to answer the question whether there is a direct relationship between students' knowledge, awareness and activism, the findings indicated that students' activism was improved in parallel with their knowledge and awareness. In contrast to Tuohino (2003) and Barraza and Walford's (2002) statements, the results of Lester et al.'s (2006) study indicated that students with adequate science knowledge tended to express activism more frequently, and that their expression of activism increased as they gained better science knowledge. The findings of this current study indicated that knowledge and awareness of the students affected their activism directly; however, assuming that the activism increases in direct proportion with

knowledge and awareness was not possible. The analysis showed that activism requires higher thinking skills than the awareness of the problems because it also involves real world problem solving skills additionally. In conclusion, the findings of this study indicated that although knowledge and awareness can be a prerequisite factor for activism, it does not necessarily result with activism.

Students' pre-test responses on the Six Americas survey indicated that some of the students were cautious and even concerned about global warming. Based on the descriptions of Six Americas Survey segments, both of these segments, especially those in the concerned group, involve awareness and even activism with regards to global warming issue. However, investigating their pre-writing prompts showed that students expressed awareness related to environmental problems very rarely while they were not able to express environmental activism at all. There might be two reasons why qualitative and quantitative findings did not indicate exactly same conclusions for some students. First, students might have environmental awareness and activism in some extent, but they might not be able to express their awareness and activism completely. Second, even though students did not have awareness and activism with regards to global warming, when they had multiple choice survey questions to answer, they made their decisions based on these choices instead of their knowledge, attitudes, awareness or activism. Gutierrez De White and Jacobson (1994) stated that subtleties of attitude change are often difficult to recognize in testing. Correspondingly, this study shows that it is worthwhile to support quantitative findings with qualitative data including media artifacts created by students to have more reliable findings especially if the attitudes, awareness, and activism of students are investigated.

Pata and Zimdin (2008) stated that most studies had not dealt with the real world environmental problem-solving skills, but investigated only knowledge, values, awareness that students claim to have and actions they claim to take; that is why, measuring awareness and activism with only surveys, rather than measuring awareness components in action, it would only be possible to measure students' knowledge of certain awareness and activism aspects. In this study, students' awareness and activism was measured through a variety of different sources including blog posts, online conversations, video projects in addition to the Six Americas Survey. Blog posts and online discussions on the social network indicated students' ability to express their awareness and activism in a simultaneous two-way interaction, whereas the media artifacts designed by the students in purpose of sharing with public reflected their awareness and activism in a more concrete form. Thus, this study provides more reliable findings in terms of student awareness and activism than studies that limit their data to surveys.

Research question #4.

The last research question aimed to show the impact of constructionist and social constructivist learning environments on students' motivation and engagement. Research findings proved that video design processes and social networking website impacted motivation and engagement of students positively. Under this particular research question, constructionist design processes and social constructivist learning environments were investigated separately to provide clearer implications.

Students reflected that the social networking website, where social constructivist processes mainly occurred, provided many benefits for them. In the particular school

where this study was conducted, absenteeism was one of the biggest challenges for both students and teachers. Since the population of this school was composed of teen mothers or pregnant teenagers, different students became home-bound at some points during the quarter which caused them having hard time catching up the instruction. The social networking website gave them the chance to follow the instructions and complete the assignments when they were not physically in the school. In their blog posts, students addressed how social networking website helped them to catch up the instruction throughout the quarter. Since students were able to adapt to the class easier when they returned to the school, they did not lose their motivation and engagement in the learning process.

By providing students their own pages and profiles on the social network, the researcher aimed to promote social presence of the students in this particular online learning environment. Picciano (2002) defined social presence is student's perceptions of being in and belonging in an online learning environment. Tu and McIsaac (2002) also defined social presence as "the degree of feeling, perception, and reaction of being connected by CMC [computer-mediated communication systems]" (p. 140). Students' reflections about their experiences on the social networking website provided evidence for the social presence of these students and the positive effects of their social presence on their performance and motivation. Students mostly stated that they enjoyed the time they spent on the website. They were more engaged in the discussions, and more comfortable interacting with each other on the social network. These findings were consistent with the research conducted by Mazer, Murphy, and Simonds (2007) who

revealed that the more personalized social networks presence the greater motivation of students to participate and learn course material.

Students also explicitly stated that they promoted each other's learning and understanding via the social networking website. They were pleased to read each other's posts and comments, which helped them to understand the content better. Although one student stated that she was not comfortable sharing her responses with others in the class, almost all other students appreciated being able to share their understanding and to hear others' thoughts about it. Even though all social constructivist researchers aim to create learning environments where students promote each other's learning, the fact that students were aware of the positive impacts of their interaction on their understanding and learning was a unique sign for the effectiveness of the social network in this particular environment.

Another advantage of using social networking website in this particular study site was giving students the chance of participating discussions and completing assignments at their own pace. The class where this study was conducted involved English Language Learners (ELL) and special education students whose learning, writing, and communication speeds were very different. In the social networking website, they were able to participate the online discussions at their pace and spend more time as needed on the assignments throughout the quarter. These students also studied the class content on the social network during their advisory hours with personal assistance.

The constructionist designing process also positively affected students' motivation and engagement. Students were more motivated to participate in learning processes while they were designing their video projects in their base groups. They were

able to work cooperatively and fulfill their responsibilities. The main factor that motivated students was the fact that students were able to reflect their identities and interests in their videos. Media literacy advocates such as Potter (2004) emphasized the importance of media production experiences in building learners' modes of production and ownership. Just like the social presence effect in social networking website, students' perceptions of reflecting their identities in their video projects positively affected their motivation and engagement in the designing process. Even though some students were not fully interested in the content of the video project at the beginning, they joined the designing efforts for the sake of reflecting their identities in the video projects. To illustrate this point, some students decided to integrate their favorite songs into their video projects, whereas some others used their favorite colors in their video template. As a particular example, one of the students who was not really engaged in any of her classes during the academic quarter took responsibility to decide the background song of their video project. She had to be an active member during the entire designing process. Therefore, she benefited from the constructionist processes as much as her friends.

The ability to control change lead to greater motivation on achievement-oriented tasks (Weiner, 1972). Since students were the only decision makers in the design process, they reflected not only their understanding but also their identities, interests, and efforts they spent in their artifacts. That is why when they received commendations about their artifacts, they appreciated their learning more. Therefore, constructionist design processes promoted greater autonomy in student actions, and students having greater autonomy took self-responsibility to complete tasks. When students presented their video projects, they stated that they were proud of not only themselves and but also other group

members. This was an important indicator that showed the positive results of cooperative work in this particular design activity.

Students expressed their appreciation about learning technology tools and design skills. Acting as instructor and researcher, my goal was to integrate technology as a mediator tool to teach environmental science content. However, conversations occurred in the classroom and the blog posts on the social networking website indicated that students actually considered the content as the mediator to learn different technologies and how to use these technologies such as designing and manipulating media tools. They frequently expressed their appreciation for learning the skills. It is fair to assume that learning new technologies was a motivation and engagement factor all by itself. Coffin and MacIntyre (1999) stated that computer-related affective states may be influenced by one's motivation to learn to use computers; therefore, students who view learning to use computers as interesting, important, and useful, are more likely to be learning for reasons such as challenge, curiosity, and mastery. Thus, whether students considered learning technology and design tools or the content of the course as the main goal of the activities, research findings showed that students' understanding, attitudes, awareness, and activism related to environmental science content were improved dramatically by the end of the study in correlation with their skills to use technology.

Implications

In this section, implications associated with students and teachers will be discussed. There are several implications of this study for both students and teachers. Implications for students are investigated as motivation, engagement, and academic

achievement whereas classroom management, technology integration, absenteeism, and student interaction in diverse classrooms are discussed as implications for teachers.

Students.

This study particularly aimed to explore the impacts of constructionist and social constructivist learning processes on students' awareness and activism. Students were the primary focus of the study. In this section, the implications of motivation, engagement, and academic achievement will be discussed. There is always a natural connection between motivation and engagement, and the increase on motivation and engagement of students usually results with academic achievement. Data from this study provides evidence for the positive impacts of constructionist designing processes and social constructivist learning environments on students' motivation, engagement, and correspondingly academic achievement. In the particular environment where this study was conducted, lack of motivation and engagement were biggest challenges students experience, which causes low academic achievement.

The findings of the study showed that students' motivation and engagement were increased dramatically. Even the students who had no interest attending classes were motivated to take responsibility and participate in the designing processes and online discussions. The statistics from the social networking website provided information that students updated their profiles, communicated with each other, and signed into the network outside of the school frequently. After the study, students mostly indicated that they would appreciate if constructionist and social constructivist methods would be implemented the following academic quarter.

This study suggests that social presence of students in the learning processes is one of the main factors affecting their motivation and engagement. When students' social presence is promoted in the learning processes, their motivation and engagement significantly increases. Therefore, students should be given the opportunity of reflecting their identities, interests, and beliefs through online learning environments, constructionist design processes, or any other learning environments and practices. In this way, students embrace the learning processes and consider themselves the main actors in the learning environments. Especially, constructivist theory and the other theories that emerged from constructivism such as constructionism and social constructivism indicate that learning occurs best when students are at the center of the learning processes.

Academic achievement is one of the most important criteria students, parents, and teachers take into account. In terms of the achievement of the students in this study, the science teacher reported that the percentage of the students who passed this class was dramatically higher than the other science classes. Integrating engaging constructionist design process and social constructivist learning environment affected students' scores in correlation with their motivation and engagement. Both formative and summative assessment results of the students showed that throughout constructionist and social constructivist learning processes, students obtained the necessary knowledge and understanding that was assigned based on the state science standards. This study indicates that integrating constructionist design processes and social constructivist learning environments into the instruction not only makes students more motivated and engaged but also increases students' academic achievement.

Teachers.

In this section, four implications for teachers are described: classroom management, technology integration, absenteeism issues, and student interaction in diverse classrooms.

This study shows that if students experience engaging activities, classroom management becomes easier. While working on the social network or designing video projects, students did not cause any problems in the classroom. While they were interacting with each other well, their behaviors did not disrupt others. Since students are more engaged in the activities during the constructionist design processes, off-topic conversations were minimized.

The second implication related to technology integration. Technology integration is a necessary skill for teachers in this century (Zhao, 2003). Teachers who want to use modern teaching methods need to be able to choose appropriate technologies to integrate into their instruction. One of the most common instructional fallacies both researchers and teachers make is technology integration without clear consideration of the pedagogical demands. In this way, technology becomes an obstacle for learning instead of being a learning tool. The technologies used in this study were based on the pedagogical frameworks of constructionism and social constructivism. The design tools that students used were appropriate for constructionist learning processes whereas the Ning social networking website promote the interaction among students as the social constructivist learning processes aim. It is important for teachers to make right decisions to use appropriate technologies in their instruction based on the methods they employ, content they teach, and the characteristic of their students.

The third implication for teachers is absenteeism problems. Absenteeism can be very challenging for the continuation of instruction. In the particular environment where the study was conducted, absenteeism was a big problem for teachers. Using a social networking website helped students to keep up with the instruction while they were not physically in the classroom. Students were also able to complete their assignments online when they were absent. Therefore, they did not lose their motivation although loss of motivation was usual when students were not able to attend the classes for a while. In addition, the instructor was able to stay on the instructional agenda because students missing the classes were not far behind the others due to the absenteeism issues.

The last implication for teachers is the interaction among students in the diverse classrooms. The class where the study was conducted involved students from different cultures. Since most of them did not know each other before the study, the interaction among students from different cultures and/or nationalities was very low at the beginning of the quarter. When students organized their profiles on the social networking website, they uploaded photos, videos, and information about themselves. While spending time on the social network, students first noticed and learned about each other on the social network. These experiences indicated that social networking technologies can be an ice breaker for students in school environment.

Suggestions for Future Research

This study holds promise for informing future research. There are five different areas that should be considered for future research initiatives as a result of this study.

First, this study was conducted in a site where all students were female. Using a more heterogeneous and/or bigger sample can help researchers to obtain findings that can

result with better generalizations. The same study can be conducted in other K-12 settings.

Second, a next step would be a comparative study between a setting with constructionist and social constructivist methods and a traditional setting. In addition, even though this study indicated that both constructionist and social constructivist frameworks affected students' awareness and activism in terms of environmental issues, it would be worthy to investigate the impacts of these frameworks separately.

Third, although there were some clues about the improvement of content knowledge of students in environmental context, this study mainly focused on students' environmental awareness and activism. Future research can investigate the impacts of constructionist and social constructivist methods on students' content knowledge.

Fourth, the design tools used in this study were appropriate for a five week constructionist designing process. These particular tools helped students to focus on the content more than design. Future research can employ more advanced design tools to further investigate the effects of design processes on students' learning and understanding.

Lastly, this particular study showed how students in the same class affected each others' awareness and activism. Future research can be conducted in a wider circle where students of different classrooms and/or cultures share the artifacts they design and interact each other in a social networking website. In this way, how the interactions among students from different learning environments promote the understanding of these students with regards to environment can be investigated.

Conclusion

Papert (1993) illustrated the power of constructionism in learning as follows:

If a man is hungry you can give him a fish, but it is better to give him a line and teach him to catch fish himself. Traditional education codifies what it thinks citizens need to know and sets out to feed children this “fish.” Constructionism is built on the assumption that children will do best by finding (“fishing”) for themselves the specific knowledge they need...the kind of knowledge children most need is the knowledge that will help them get more knowledge (p. 139).

Through the constructionist learning processes, students seek to understand the process of learning, instead of simply becoming consumers of knowledge (Papert, 1993). As constructionist research indicated, giving students the freedom to create artifacts that reflect their identity, understanding, and effort, students realize that they create more than artifacts but knowledge in a meaningful way. Thus, the objectives that students gain from constructionist learning processes last a lifetime, which is the key point in terms of awareness and activism students need to have not during an academic year but throughout their life.

References

- American Association for the Advancement of Science. (1989). *Science for all Americans*. New York: Oxford University Press.
- American Association for the Advancement of Science. (1993). *Benchmarks for science literacy*. New York: Oxford University Press.
- Abbitt, J. (2007). Exploring the educational possibilities for a user-driven social content system in an undergraduate course. *MERLOT: Journal of Online Learning and Teaching*, 3(4), 437-447.
- Abdal-Haqq, I. (1998). Constructivism in teacher education: Considerations for those who would link practice to theory. ERIC digest.
- Ackermann, E. (2001). Piaget's constructivism, Papert's constructionism: What's the difference. *Future of Learning Group Publication*, 5(3), 438-442.
- Ackermann, E. (2010). Constructivism (s): Shared roots, crossed paths, multiple legacies. Paper presented at the *Clayson JE, Kalaš I.(Eds.) Constructionist Approaches to Creative Learning and Education: Lessons for the 21st Century. Proc. Constructionism 2010. 12th European Logo Conference, 16–20 August 2010, Paris, France*, 1-8.
- Aikenhead, G. S. (1994). What is STS science teaching? In J. Solomon, & G. Aikenhead (Eds.), *STS education: International perspectives in reform* (pp. 47–59). New York: Teachers College Press.
- Altin M., Bacanlı, H., & Yildiz, K. (2002). Biyoloji öğretmen adaylarının çevreye yönelik tutumları [*Pre-service biology teachers' attitudes toward environment*],

Orta Dogu Teknik Universitesi, V. Ulusal Fen Bilimleri ve Matematik Egitimi Kongresi, Ozet Kitabi, Ankara.

Apple, M. W. (2000). *Official knowledge: Democratic education in a conservative age* (2nd ed.). New York: Routledge.

Barraza, L., & Walford, R. A. (2002). Environmental education: A comparison between English and Mexican school children. *Environmental Education Research*, 8(2), 171-186.

Baytak, A. (2009). An investigation of the artifacts, outcomes, and processes of constructing computer games about environmental science in a fifth grade science classroom. Ph.D. dissertation, The Pennsylvania State University, United States -- Pennsylvania. Retrieved May 3, 2012, from Dissertations & Theses: A&I.(Publication No. AAT 3399626).

Baytak, A. (2011). Towards effective instructions in environmental education: A critical review of literature. *European Journal of Physics Education*, 2(1), 28-37.

Baytak, A., & Land, S. M. (2010). A case study of educational game design by kids and for kids. *Procedia - Social and Behavioral Sciences*, 2(2), 5242-5246.

Beck, C., & Kosnik, C. M. (2006). *Innovations in teacher education: A social constructivist approach*. Albany, NY: State University of New York Press.

Bingle, W. H., & Gaskell, P. J. (1994). Scientific literacy for decision making and the social construction of scientific knowledge. *Science Education*, 78(2), 185-201.

Bouillion, L. M., & Gomez, L. M. (2001). Connecting school and community with science learning: Real world problems and school – community partnerships as contextual scaffolds. *Journal of Research in Science Teaching*, 38(8), 878-898.

- Boyd, D. M., & Ellison, N. B. (2007). Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication*, 13(1), 210-230.
- Brophy, J. (2006). Graham Nuthall and social constructivist teaching: Research-based cautions and qualifications. *Teaching and Teacher Education*, 22(5), 529-537.
- Bruckman, A. (1998). Community support for constructionist learning. *Computer Supported Cooperative Work (CSCW)*, 7(1), 47-86.
- Bruckman, A., & Resnick, M. (1995). The MediaMOO project. *Convergence: The International Journal of Research into New Media Technologies*, 1(1), 94-109.
- Bybee, R. (1991). Science–technology–society in science curriculum: The policy–practice gap. *Theory into Practice*, 30(4), 294–302.
- Bybee, R. (1993). *Reforming science education: Social perspectives and personal reflections*. New York: Teachers College Press.
- Caldarelli, M. K. (2004). Targeting environmental beliefs in a community college environmental science course. D.Ed. dissertation, The Pennsylvania State University, United States - Pennsylvania. Retrieved May 1, 2012, from Dissertations & Theses: A&I. (Publication No. AAT 3147593).
- Cetin, G., & Nisanci, S. H. (2010). The effectiveness of the new 9th grade biology curriculum on students' environmental awareness. Paper presented at the *Asia-Pacific Forum on Science Learning and Teaching*, 11(2), 1-25.
- Chandler, K., & Swartzentruber, M. (2011). A correlational study of nature awareness and science achievement. *Online Submission*, M.A. Thesis, Johnson Bible College.

- Cismas, S. C., Vajjala, G., & Andreiasu, G. (2011). Promoting social awareness via e-education. Paper presented at the *Proceedings of the 5th European Conference on European Computing Conference*, 41-45.
- Coertjens, L., Boeve-de Pauw, J., De Maeyer, S., & Van Petegem, P. (2010). Do schools make a difference in their students' environmental attitudes and awareness? Evidence from Pisa 2006. *International Journal of Science and Mathematics Education*, 8(3), 497-522.
- Coffin, R.J., & MacIntyre, P.D. (1999). Motivational influences on computer-related affective states. *Computers in Human Behavior*, 15, 549-569.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Earlbaum Associates.
- Conole, G., & Culver, J. (2009). Cloudworks: Social networking for learning design. *Australasian Journal of Educational Technology*, 25(5), 763-782.
- Creswell, J. W. 2003. *Research design: Quantitative, qualitative, and mixed methods approaches*. Thousand Oaks, CA: Sage.
- Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five traditions* (2nd ed). Thousand Oaks, CA: Sage.
- Creswell, J. W., & Clark, V. L. P. (2010). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage.
- Cross, R. T., & Price, R. F. (1999). The social responsibility of science and the public understanding of science. *International Journal of Science Education*, 21(7), 775-785.

- Dalsgaard, C. (2008). Social networking sites: Transparency in online education. *EUNIS 2008 proceedings*, Aarhus, June 24 - 27, 2008.
- Dewey, J. (1897). *My pedagogic creed*. New York: EL Kellogg & Co.
- Eijkelfhof, H. M. C., & Lijnse, P. L. (1988). The role of research and development to improve STS-education: experiences from the PLON project. *International Journal of Science Education*, 20(4), 464-474.
- Eisner, E. W., & Peshkin, A. (1990). *Qualitative inquiry in education: The continuing debate*. New York: Teachers College Press.
- Evans, S., Gill, M., & Marchant, J. (1996). School children as educators: The indirect influence of environmental education in schools on parents' attitudes towards the environment. *Journal of Biological Education*, 30(4), 243-248.
- Falbel, A. (1991). The computer as a convivial tool. In Harel, I. & Papert, S. *Constructionism* (pp. 29-37). Norwood NJ: Ablex Publishing.
- Fisman, L. (2005). The effects of local learning on environmental awareness in children: An empirical investigation. *The Journal of Environmental Education*, 36(3), 39-50.
- Fusco, D. (2001). Creating relevant science through urban planning and gardening. *Journal of Research in Science Teaching*, 38(8), 860-877.
- Giroux, H. (2002). Democracy, freedom, and justice after September 11th: Rethinking the role of educators and the politics of schooling. *The Teachers College Record*, 104(6), 1138-1162.

- Grant, M. M. (2002). Getting a grip on project-based learning: Theory, cases and recommendations. *Meridian: A Middle School Computer Technologies Journal*, 5(1), Retrieved May 1, 2012 from <http://www.ncsu.edu/meridian/win2002/514>.
- Griffith, S., & Liyanage, L. (2008). An introduction to the potential of social networking sites in education. In I. Olney, G. Lefoe, J. Mantei, & J. Herrington (Eds.), *Proceedings of the Second Emerging Technologies Conference 2008* (pp. 76-81). Wollongong: University of Wollongong. Retrieved November 2, 2011, from <http://ro.uow.edu.au/etc08/9>
- Gunawardena, C. N., Hermans, M. B., Sanchez, D., Richmond, C., Bohley, M., & Tuttle, R. (2009). A theoretical framework for building online communities of practice with social networking tools. *Educational Media International*, 46(1), 3-16.
- Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research*, 17(4), 397-431.
- Gutierrez de White, T., & Jacobson, S.K. (1994). Evaluating conservation education programs at a South American zoo. *Journal of Environmental Education*, 25(4), 18-22.
- Han, S., & Bhattacharya, K. (2001). Constructionism, learning by design, and project based learning. In M. Orey (Ed.), *Emerging perspectives on learning, teaching, and technology*. Retrieved December 29, 2011, from <http://www.coe.uga.edu/epltt/LearningbyDesign.htm>

- Hansen, A. (2000). Claims-making and framing in British newspaper coverage of the 'Brent Spar' controversy. In: Allan, S., Adam, B., & Carter, C. (Eds). *Environmental Risks and the Media*. (pp. 55-72). London: Routledge.
- Harel, I. (1991). *Children designers: Interdisciplinary constructions for learning and knowing mathematics in a computer-rich school*. Norwood, NJ: Ablex Publishing.
- Harel, I., & Papert, S. (1990). Software design as a learning environment. *Interactive Learning Environments*, 1(1), 1-32.
- Harel, I. E., & Papert, S. E. (1991). *Constructionism*. Norwood, NJ: Ablex Publishing.
- Harel, I. & Papert, S. (1991). Software design as learning environment. In I. Harel S. Papert. (Eds.). *Children designers: Interdisciplinary constructions for learning and knowing mathematics in a computer-rich school* (pp.41-85). Norwood, NJ: Ablex Publishing.
- Hausfather, S. J. (1996). Vygotsky and schooling: Creating a social context for learning. *Action in Teacher Education*, 18(2), 1-10.
- Heath, P. A. (1992). Organizing for STS teaching and learning: The doing of STS. *Theory into Practice*, 31(1), 52-58.
- Hirtle, J. S. P. (1996). Social constructivism (coming to terms). *English Journal*, 85(1), 91-92.
- Hodson, D. (2003). Time for action: Science education for an alternative future. *International Journal of Science Education*, 25(6), 645-670.
- Huber, M., & Knutti, R. (2011). Anthropogenic and natural warming inferred from changes in Earth's energy balance. *Nature Geoscience*, 5, 31-36.

- Huckle, J. (1991). Education for sustainability: Assessing pathways to the future, *Australian Journal of Environmental Education*, 7, 43-62.
- Hungerford, H., Peyton, R. B., & Wilke, R. J. (1980). Goals for curriculum development in environmental education. *The Journal of Environmental Education*, 11(3), 42-47.
- Hungerford, H. R. (1985). *Investigating and evaluating environmental issues and actions: Skill development modules. A curriculum development project designed to teach students how to investigate and evaluate science-related social issues. Modules I-VI. Teacher's edition.* Champaign, IL: Stipes Publishing Co.
- Hungerford, H. R., & Volk, T. L. (1990). Changing learner behavior through environmental education. *Journal of Environmental Education*, 21(3), 8-22.
- Hurd, P. D. (1997). *Inventing science education for the new millennium.* New York: Teachers College Press.
- Hurd, P. D. (1998). Scientific literacy: New minds for a changing world. *Science Education*, 82(3), 407–416.
- IPCC (2001). *Climate change 2001: The scientific basis, contribution of working group I to the third assessment report of the intergovernmental panel on climate change.* In Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, & C.A. Johnson (Eds) (pp. 881). Cambridge: Cambridge University Press.
- Jenkins, K. (2009). Linking theory to practice: Education for sustainability and learning and teaching. In M. Littledyke, N. Taylor & C Eames (Eds.) *Education for*

- sustainability in the primary curriculum: A guide for teachers* (pp. 29-38). South Yarra, Australia: Palgrave Macmillan.
- Jensen, B. B. (2002). Knowledge, action and pro-environmental behaviour. *Environmental Education Research*, 8(3), 325-334.
- Jinliang, W., Yunyan, H., Ya, L., Xiang, H., Xiafei, W., & Yuanmei, J. (2004). An analysis of environmental awareness and environmental education for primary school and high school students in kunming. *Chinese Education & Society*, 37(4), 24-31.
- Johnson, D. W., Johnson, R. T., & Johnson Holubec, E. (2008). *Cooperation in the classroom* (Revised edition). Edina, MN: Interaction Book Co.
- Kafai, Y. B., & Ching, C. C. (2001). Affordances of collaborative software design planning for elementary students' science talk. *The Journal of the Learning Sciences*, 10(3), 323-363.
- Kafai, Y. B. (2005). The classroom as living laboratory: design-based research for understanding, comparing, and evaluating learning science through design. *Educational Technology*, 45(1), 28-34.
- Kafai, Y. B. (2006). Playing and making games for learning. *Games and Culture*, 1(1), 36-40.
- Kim, B., 2001. Social constructivism. In M. Orey. (ed.), *Emerging perspectives on learning, teaching, and technology*. Retrieved April 29, 2012, from <http://www.coe.uga.edu/epltt/SocialConstructivism.htm>.
- Lenhart, A., & Madden, M. (2007). *Teens, privacy, and online social networks: how teens manage their online identities and personal information in the age of my*

- space*. Pew Internet & American Life Project report. Retrieved December 10, 2011 from http://www.pewinternet.org/PPF/r/211/report_display.asp.
- Lester, B. T., Ma, L., Lee, O., & Lambert, J. (2006). Social activism in elementary science education: A science, technology, and society approach to teach global warming. *International Journal of Science Education*, 28(4), 315-339.
- Littledyke, M. (2008). Science education for environmental awareness: Approaches to integrating cognitive and affective domains. *Environmental Education Research*, 14(1), 1-17.
- Lockyer, L., & Patterson, J. (2008). Integrating social networking technologies in education: A case study of a formal learning environment. Paper presented at the *Proceeding of 8th IEEE International Conference on Advanced Learning Technologies, Spain*, 529–533.
- Macdonald, D., & Hoban, G. (2009). Developing science content knowledge through the creation of slowmations. *The International Journal of Learning*, 16(6), 319-330.
- Maibach, E.W, Leiserowitz, A., Roser-Renouf, C., Mertz, C. K. (2011) Identifying like-minded audiences for global warming public engagement campaigns: An audience segmentation analysis and tool development. *PLoS ONE* 6(3): e17571. doi:10.1371/journal.pone.0017571
- Maibach, E.W., Leiserowitz, A., Roser-Renouf, C., Mertz C.K., & Akerlof, K. (2011). Global Warming's Six Americas screening tools: Survey instruments; instructions for coding and data treatment; and statistical program scripts. Yale University and George Mason University. Yale Project on Climate Change Communication, New

- Haven, CT. Retrieved October 27, 2011, from
<http://climatechangecommunication.org/SixAmericasManual.cfm>
- Maloney, E. J. (2007). What web 2.0 can teach us about learning. *Chronicle of Higher Education*, 53(18), B26–B27.
- Mansour, N. (2007). Challenges to STS education: Implications for science teacher education. *Bulletin of Science, Technology & Society*, 27(6), 482-497.
- Mathis, C. (2011). What are Supports and Barriers to Using Social Constructivism and the Reggio Emilia Approach in State Funded Preschool Programs in California? Ed.D. dissertation, University of California, Davis, United States - California. Retrieved May 27, 2012, from Dissertations & Theses: A&I. (Publication No. AAT 3474428).
- Maxwell, J. (2006). Re-situating constructionism. In J. Weiss, J. Nolan, J. Hunsinger, & P. Trifonas (Eds.). *The International Handbook of Virtual Learning Environments* (pp. 279-298). Netherlands: Springer.
- 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.
- McMichael, P. (2000). *Development and social change: A global perspective*. Thousand Oaks, CA: Pine Forge Press.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis* (2nd ed.). Thousand Oaks, CA: Sage.

- Millar, R., & Osborne, J. (Eds.) (1998). *Beyond 2000: Science education for the future (the report of a seminar series funded by the Nuffield Foundation)*. London: King's College London.
- Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing Research, 40*(2), 120-123.
- Mutisya, S. M., & Barker, M. (2011). Pupils' environmental awareness and knowledge: A springboard for action in primary schools in Kenya's rift valley. *Science Education International, 22*(1), 55-71.
- National Research Council. (1996). *National science education standards*. Washington, DC: National Academy Press.
- National Science Teachers Association (NSTA). (1993). Science/technology/society: A new effort for providing appropriate science for all. In R. E. Yager (Ed.), *The science, technology, society movement* (pp. 3–5). Washington, DC: NSTA Special Publications.
- Newman, J. M. (1990). *Finding our own way: Teachers exploring their assumptions*. Portsmouth, NH: Heinemann Educational Books Inc.
- Newstetter, W. C. (2000). *Design education: A special issue of the journal of the learning sciences*. Mahwah, NJ: Lawrence Erlbaum Associates Inc.
- North, K. (1997). *Environmental business management: An introduction*. Geneva, Switzerland: International Labour Organization.
- Obsessed with Facebook. Available December 4, 2011, from Online Schools Web site, <http://www.onlineschools.org/blog/facebook-obsession/>

- Oldfather, P., West, J., White, J., & Wilmarth, J. (1999). *Learning through children's eyes: Social constructivism and the desire to learn*. Washington, DC: American Psychological Association.
- Olson, M. (2007). Examining collaborative real world application activities in online environments: Implications for design. Ed.D. dissertation, University of Massachusetts Lowell, United States -- Massachusetts. Retrieved May 23, 2012, from Dissertations & Theses: A&I.(Publication No. AAT 3252756).
- Organisation for Economic Cooperation and Development (OECD). (1998). *Instrument design: A framework for assessing scientific literacy*. Report of Project Managers Meeting, Arnhem, The Netherlands: Programme for International Student Assessment.
- Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas* New York: Basic Books Inc.
- Papert, S., & Massachusetts Institute of Technology. Epistemology & Learning Research Group. (1986). *Constructionism: A new opportunity for elementary science education*. Massachusetts Institute of Technology, Media Laboratory, Epistemology and Learning Group.
- Papert, S. (1990). An introduction to the fifth anniversary collection. In I. Harel (Ed.), *Constructionist Learning*. Cambridge, MA: MIT Media Laboratory.
- Papert, S. (1991). Situating constructionism. In I. Harel, & S. Papert (Eds.), *Constructionism* (pp. 1 - 12). Norwood, NJ: Ablex Publishing.
- Papert, S. (1993). *The children's machine*. New York, NY: Basic Books.

- Papert, S. (1999). What is logo? Who needs it? In *Logo Philosophy and Implementation* (pp. VIII- IX). Montreal, Canada: LCSl.
- Pata, K., & Metsalu, E. (2008). Conceptualizing awareness in environmental education: An example of knowing about air-related problems. *Science Education International, 19*(1), 24.
- Pata, K., & Zimdin, L. (2008). Teaching for environmental awareness and conceptual coherence of air related problems. In P. Pace (Ed.). *Thinking and acting outside the box. A European contribution to the UN decade of education for sustainable development* (p. 8-15). CEEE 10th Conference. Malta, 15-19 October.
- Patton, M. Q (1990). *Qualitative evaluation and research methods* (2nd ed.). Newbury Park, CA: Sage.
- Patronis, T., Potari, D., & Spiliotopoulou, V. (1999). Students' argumentation in decision-making on a socio-scientific issue: Implications for teaching. *International Journal of Science Education, 21*(7), 745-754.
- Pederson, D. M. (1999). Dimensions of environmental competence. *Journal of Environmental Psychology, 19*(3), 303-308.
- Pedretti, E. (1997). *Schools and science centers working together: An STS issues-based approach to learning science*. Paper presented at the National Association for Research in Science Teaching (NARST), Chicago.
- Pedretti, E. (1999). Decision making and STS education: Exploring scientific knowledge and social responsibility in schools and science centers through an issue-based approach. *School Science and Mathematics, 99*(4), 174–181.

- Pempek, T. A., Yermolayeva, Y. A., & Calvert, S. L. (2009). College students' social networking experiences on facebook. *Journal of Applied Developmental Psychology, 30*(3), 227-238.
- Perkins, D. N. (1986). *Knowledge as design*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Picciano, A. (2002). Beyond student perceptions: issues of interaction, presence, and performance in an online course. *Journal of Asynchronous Learning Networks, 6*(1), 21-40.
- Pinkett, R. D. (2000). Bridging the digital divide: Sociocultural constructionism and an asset-based approach to community technology and community building. Paper presented at the *St Annual Meeting of the American Educational Research Association (AERA)*, (pp.24-28), New Orleans, LA.
- Pomerantz, L. (1991). Evaluation of natural resource education materials: Implications for resource management. *Journal of Environmental Education, 22*(2), 16-23.
- Potter, W. J. (2004). Argument for the need for a cognitive theory of media literacy: Media literacy in the future. *American Behavioral Scientist, 48*(2), 266-272.
- Prasolova-Forland, E. (2002). *Supporting awareness in education: Overview and mechanisms*. Paper presented at the International Conference on Engineering Education, Manchester, U.K.
- Pritchard, A. (2010). *Psychology for the classroom: Constructivism and social learning*. Hoboken, NJ: Taylor & Francis.
- Rahm, J. (2002). Emergent learning opportunities in an inner - city youth gardening program. *Journal of Research in Science Teaching, 39*(2), 164-184.

- Resnick, M. (1991). Xylophones, hamsters, and fireworks: The role of diversity in constructionist activities. In I. Harel, & S. Papert (Eds.) *Constructionism* (pp.1-12). Norwood, NJ: Ablex Publishing.
- Resnick, M., & Ocko, S. (1991). LEGO/Logo: Learning through and about design. In I. Harel, & S. Papert (Eds.) *Constructionism* (pp.141-150). Norwood, NJ: Ablex Publishing.
- Resnick, M., Ocko, S., & Papert, S. (1988). LEGO, logo, and design. *Children's Environments Quarterly*, 5(4), 14-18.
- Reynolds, R., & Caperton, I. H. (2009). *The emergence of six contemporary learning abilities (6-CLAs) in middle school, high school and community college students as they design web-games and use project-based social media in globaloria*. Paper presented at the Annual Conference of the American Educational Research Association, San Diego, CA, April, 2009.
- Reynolds, R., & Caperton, I. H. (2011). Contrasts in student engagement, meaning-making, dislikes, and challenges in a discovery-based program of game design learning. *Educational Technology Research and Development*, 59(2), 267-289.
- Richardson, V. (1997). Constructivist teaching and teacher education: Theory and practice. In V. Richardson (Ed.), *Constructivist Teacher Education: Building New Understandings* (pp. 3-14). Washington, DC: Falmer Press.
- Roberts, D. F., Foehr, U. G., & Rideout, V. (2005). *Generation M: Media in the lives of 8-18 year-olds*. Menlo Park, CA: Kaiser Family Foundation.

- Roth, C. (1992). *Environmental literacy: Its roots, evolution and directions in the 1990s*. Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education.
- Rosenthal, D. B. (1990). Warming up to STS activities to encourage environmental awareness. *Science Teacher*, 57(6), 28-32.
- Russell, C. (1999). The three T's: Approaches to environmental learning. *Pathways: The Ontario Journal of Outdoor Education*, 12(2), 4-6.
- Sadler, T. D., Chambers, F. W., & Zeidler, D. L. (2004). Student conceptualizations of the nature of science in response to a socioscientific issue. *International Journal of Science Education*, 26(4), 387-409.
- Salomon, G., Perkins, D. N., & Globerson, T. (1991). Partners in cognition: Extending human intelligence with intelligent technologies. *Educational Researcher*, 20(3), 2-9.
- Social networking site. Available February 22, 2012, from PC Magazine Web site http://www.pcmag.com/encyclopedia_term/0,2542,t=social+networking+site&i=55316,00.asp
- Solomon, J. (1994). Knowledge, values, and the public choice of science knowledge. In J. Solomon, & G. Aikenhead (Eds.). *STS education: International perspectives in reform* (pp. 99-111). New York: Teachers' College Press.
- Sefton-Green, J. (2004). Literature review in informal learning with technology outside school: A Report for NESTA Futurelab (no 7); Retrieved December 4, 2011, from http://www.nestafuturelab.org/research/reviews/07_01.htm

- Selwyn, N. (2007). *Web 2.0 applications as alternative environments for informal learning-a critical review*. Paper presented at the Paper for OCEDKERIS Expert Meeting. Session 6: Alternative learning environments in practice: using ICT to change impact and outcomes.
- Skillen, M. A. (2008). Promoting thinking skills within the secondary classroom using digital media. In M. Kendall, & B. Samways (Eds.), *IFIP International Federation for Information Processing, Volume 281; Learning to Live in the Knowledge Society* (pp. 119-126). Boston: Springer.
- Spork, H. (1992). Environmental education: A mismatch between theory and practice. *Australian Journal of Environmental Education*, 8, 147-166.
- Stager, G. S. (2003). The feeling of wonderful ideas: Implications for the future of teaching and learning. Paper presented at the *Proceedings of the 3.1 and 3.3 Working Groups Conference on International Federation for Information Processing: ICT and the Teacher of the Future*, 23, 111-113.
- Stapp, W. B., Bennett, D., Bryan, W., Fulton, J., MacGregor, J., & Nowak, P. (1969). The concept of environmental education. *Journal of Environmental Education*, 1(1), 30-31.
- Tanner, C. (1999). Constraints on environmental behaviour. *Journal of Environmental Psychology*, 19, 145-157.
- Tilbury, D. (1995). Environmental education for sustainability: Defining the new focus of environmental education in the 1990s. *Environmental Education Research*, 1(2), 195-212.

- Tu, C. H., & McIsaac, M. S. (2002). An examination of social presence to increase interaction in online classes. *American Journal of Distance Education, 16*(2), 131-150.
- Tuohino, A. (2003). Environmental awareness and environmentally friendly behavior—case sulkava rowing event. *Environment Papers Series, 6*(2), 1-11.
- Tynes, B. M. (2007). Internet safety gone wild? *Journal of Adolescent Research, 22*(6), 575-584.
- UNESCO (1976). *The Belgrade Charter*. New York: United Nations.
- UNESCO. (1977). *Final report*. Paper presented at the Intergovernmental Conference on Environmental Education, Tbilisi, Republic of Georgia: USSR.
- UNESCO–UNEP, (1978). "The Tbilisi Declaration". *Connect, Vol. III* (1), pp.1–8.
- Van Manen, M. (1990). *Researching lived experience: Human science for an action sensitive pedagogy*. Albany, NY: State University of New York Press.
- Vygotsky, L. S. (1986). *Thought and language*. Cambridge, MA: The MIT Press.
- Vygotsky, L. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.
- Waks, L. J. (1992). The responsibility spiral: A curriculum framework for STS education. *Theory into Practice, 31*(1), 13–19.
- Weiner, B. (1972). Attribution theory, achievement motivation, and the educational process. *Review of Educational Research, 42*(2), 203-215.
- Wu, L. (2001). *Integrated learning of mathematics, science and technology concepts through LEGO/Logo projects*. Unpublished doctoral dissertation. Michigan State University.

- Yager, R.E. (1992). Science-technology-society as reform. In R.E. Yager (Ed.), *The status of STS: Reform efforts around the world* (pp. 2-8). ICASE 1992 Yearbook. Knapp Hill, South Harting, Petersfield GU31 5LR, UK: International Council of Associations for Science Education.
- Yager, R. E., & Roy, R. (1993). STS: Most pervasive and most radical of reform approaches to “science” education. In R. E. Yager (Ed.), *The science, technology, society movement* (pp. 7–13). Washington, DC: NSTA Special Publications.
- Zeidler, D. L. (2001). Standard F: Participating in program development. In E. Siebert, & W. McIntosh (Eds.), *Pathways to the Science Standards: College Education* (pp. 18 – 22). Arlington, VA: National Science Teachers Press.
- Zeidler, D. L., Sadler, T. D., Simmons, M. L., & Howes, E. V. (2005). Beyond STS: A research-based framework for socioscientific issues education. *Science Education*, 89(3), 357-377.
- Zhao, Y. (2003). What teachers need to know about technology?: Framing the question. In Y. Zhao (Ed.), *What should teachers know about technology?: Perspectives and practices* (pp. 1-14). Greenwich, CO: Information Age Publishing.
- Ziman, J. M. (1980). *Science and society education*. Cambridge: Cambridge University Press.