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Interdisciplinary Journal of Problem-Based Learning

Volume 5 | Issue 2 Article 6

Published online: 9-27-2011

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Michael M. Grant
*University of Memphis*



Recommended Citation
Grant, M. M. (2011). Learning, Beliefs, and Products: Students' Perspectives with Project-based Learning. *Interdisciplinary Journal of Problem-Based Learning*, *5*(2).
Available at: http://dx.doi.org/10.7771/1541-5015.1254

# Learning, Beliefs, and Products: Students' Perspectives with Project-based Learning

*Michael M. Grant*

## Abstract

Project-based learning offers promise as an instructional method that affords authentic learning tasks grounded in the personal interests of learners. While previous research has presented results of learning gains, motivations, and teacher experiences, limited empirical research has presented student perspectives in project-based learning. This research sought to explore how learners created projects. A qualitative case study design was employed with five purposively selected participants from eighth grade geography at a private day school. From interviews, observations, and document collection, five themes emerged from what influenced participants' projects and what the participants learned: (1) internal influences, (2) external influences, (3) beliefs about projects, (4) tools for technology-rich environments, and (5) learning outcomes and products. The first four themes describe influences to shape the fifth theme, learning products. The term learning products was used to describe both the learning acquired by the participants and the learning artifacts the participants produced as part of the instructional unit. Implications for practice and future research are considered.

The Interdisciplinary Journal of Problem-Based Learning • volume 5, no. 2 (Fall 2011)

37-69

http://dx.doi.org/10.7771/1541-5015.1254

## Introduction

Project-based learning offers promise as an instructional method that affords authentic learning tasks grounded in the personal interests of learners. While there are a number of definitions of project-based learning, the critical components of the model emphasize (a) a driving question or problem and (b) the production of one or more artifacts as representations of learning (Adderley et al., 1975; Blumenfeld et al., 1991). Rieber (2004) notes that "projects, as external artifacts, are public representations" (p. 592) of a learner's solution to a guiding question. Inherently linked to constructionism (Harel & Papert, 1991; Kafai & Resnick, 1996), the production of a learning artifact is what consequentially "distinguishes project-based learning from problem-based learning" (Helle, Tynjala, & Olkinuora, 2006, p. 291). Many of the principles of project-based learning are common to problem-based learning as well. However, while the emphasis in project-based learning may center on the production of a learning artifact, problem-based learning seems to require "the acquisition of new knowledge and the solution may be less important than the knowledge gained in obtaining it" (Prince & Felder, 2006, p. 130). Learning occurs through the process of constructing the artifact, so the end product is critical to the learning goals (Prince & Felder, 2006; Williams van Rooij, 2009).

The potential benefits of project-based learning are substantial. Proponents of project-based learning have lauded the emphasis on in-depth investigations over memorization of broad content knowledge (Harris & Katz, 2001, 2004). Harel and Papert (1991), Kafai and Resnick (1996), and more recently, Hug, Krajcik, and Marx (2005) and Wang (2009) have suggested learner motivations to complete projects are heightened when projects are personally relevant. Additionally, Tassainari (1996) and Worthy (2000) assert project-based approaches offer learners opportunities to guide, manage and monitor their learning through self-direction and self-regulation. Project-based learning also has the potential to integrate collaboration and cooperation meaningfully (e.g., Helle et al., 2006; Lou & MacGregor, 2004; Mitchell, Foulger, Wetzel, & Rathkey, 2009), where student teams remain intact throughout a project or individuals use peer reviews and more informal social negotiations. Lessons employing project-based learning also use a variety of resources, tools, and scaffolds (Dodge, 1995, 1998; Helle et al., 2006; Williams van Rooij, 2008). Finally, some project-based learning lessons make use of reflection (Dodge, 1995, 1998; Fell, 1998; Grant & Branch, 2005), such as short reflections at the end of class periods, learning logs, and modified KWL (What I Know, What I Want to Know, What I Still Need to Learn; Ogle, 1986) charts.

The principles of project-based learning are observed in many instructional methods and pedagogies, such as project-based science (Blumenfeld et al., 1991; Marx, Blumenfeld, Krajcik, & Soloway, 1997), disciplined inquiry (Levstik & Barton, 2001), open-ended learning environments (Hannafin, Hall, Land, & Hill, 1994; Hannafin, Land, & Oliver, 1999),

WebQuests (Dodge, 1995, 1998), and student-centered learning environments (Land & Hannafin, 2000). In this study, I followed Adderley et al. (1975) and Blumenfeld et al.'s (1991) requirements for a driving question or investigation and the production of a tangible artifact. In addition, I included Grant's (2002) elements for project-based learning: (a) an introduction, emotional anchor, or mission, (b) definition of the learning task, (c) procedure for investigation, (d) suggested resources, (e) scaffolding mechanisms, (f) collaborations, and (g) reflections and transfer activities.

Implementation of project-based learning is challenging. In particular, Veermans, Lallimo, and Hakkarainen (2005) considered the inefficiency of project-based learning. For example, with increased competition among curricular objectives, the quantities of time dedicated to in-depth inquiries are difficult for teachers to reconcile. In addition, project-based learning requires a shift in roles for the teacher and learners away from didactic instruction (Clark, 2006; Grant & Hill, 2006). In fact, Mitchell et al. (2009) suggest that teachers may implement project-based learning in a "hybrid" method, where their pedagogical beliefs remain unchanged from direct instruction orientations, resulting in more prescribed learner products. Finally, assessment in project-based learning has been focused on summative assessment of products (Barak, 2005). Helle et al. (2006) have argued for embedding "multiple opportunities for formative assessment and revision" that would reflect more authentic contexts and document learners' decision-making during the learning process.

## *Statement of the Problem*

While Blumenfeld (e.g., Blumenfeld, Krajcik, Marx, & Soloway, 1994; Blumenfeld et al., 1991; Marx et al., 1997) and others (Brush & Saye, 2000; Meyer, Turner, & Spencer, 1997; Turner, Meyer, Midgley, & Patrick, 2003) have presented results of learning gains, motivations, and teacher experiences, limited empirical research has presented the student perspective in project-based learning (cf., Beckett, 2005; Land & Greene, 2000; Wu & Krajcik, 2006). If indeed project-based learning is rooted in constructivism and constructionism, if project-based learning is founded in the personal interests and motivations of the learner, and if the learning artifacts are representations of a learner's knowledge, then it is paramount that we come to understand how learners negotiate projects and what they learn during project-based learning lessons. Our previous research (see Grant & Branch, 2005) explored how participants used their abilities during project-based learning. This current research sought to explore how the learners created projects and how they chose to complete the learning tasks. We were particularly interested in (a) what influenced the creation of projects and (b) what the students learned as a result of completing the project. The primary research question was "From the perspective of students engaged in project-based learning, what influences their project work and learning?" Beckett (2005) argued that students' perspectives of project-based learning have been too simplified, "what students

do with and say" about projects is "complex," and improved studies should communicate "the dilemmas" students face (p. 195). This research attempted to address this complexity and focused on the students' viewpoints—not discounting the teacher from the learning environment but delimiting her perspective for this study.

## Methodology

The case study method (Merriam, 1998) was used in order to study both the process and products of learning over time and was bounded by the project-based learning unit. Case study affords multiple methods for data collection, including interviews, observation, and artifacts (Yin, 2003). The initial unit of analysis was each participant individually, and then themes were developed by aggregating findings across all participants. By using a case study design, I sought to produce a "holistic description and explanation" to the research question (Merriam, 1998, p. 29).

### *Context*

The setting for this study was an eighth grade geography class at a small, private day school in the southeastern United States. There were approximately 15 students in each class period with the teacher covering 4 periods per day. The geography curriculum was centered on themes, such as population, conflict, and famine, to discuss the human and physical geographies of the world.

The day school afforded ubiquitous computing and access to the Internet and school intranet at any time. The school had implemented an initiative to integrate laptop computers into their academic curriculum and had a long history of technology innovations. Eighth grade teachers had been using laptops for approximately three years, while the eighth graders were in their second year of using laptop computers. Teachers at the school primarily employed didactic instructional methods (i.e., lecture, direct instruction). As a result, the students at the private school had little experience with project-based learning. However, with the introduction of laptop computers, the teachers and administration had expressed a desire to move toward more student-centered approaches and self-directed learning, such as project-based learning.

### *Description of the Unit*

For this study, the cooperating geography teacher and I collaborated to design an extensive long-term WebQuest that incorporated (a) Adderley et al. (1975) and Blumenfeld et al.'s (1991) requirements for a driving question or investigation and the production of a tangible artifact, (b) Grant's (2002) elements of project-based learning and (c) the laptop computers in a more significant manner (see Table 1.) In particular, we used the WebQuest

site as metacognitive, procedural, and strategic scaffolds (Hill & Hannafin, 2001) in order to facilitate students' progress through the unit, as well as students' efforts in managing discrete approaches to tasks. We planned a unit on geography and human rights that lasted ten weeks. During the planning, we selected five countries spread across the globe—in contrast to previous years where units were organized by geographical regions traversing the globe—where citizens were currently experiencing violations against human rights. These countries were Argentina, Kashmir, Sierra Leone, Sri Lanka, and Sudan. The unit was specifically designed to transition the eighth graders from novices to experts on topics related to human rights. Jonassen, Mayes, and McAleese (1993) have argued that as students move toward more expert knowledge, they have the ability to take more responsibility for their learning and assert more personal perspectives. The unit on human rights was designed in this manner to become more student centered as the unit advanced.

The human rights unit was divided into four stages. Stage One included learning the physical and human geographies of all the countries under study. Students researched using Internet and print resources and collated their facts into a spreadsheet template created by the teacher and researcher. Stage Two asked students to define human and civil rights, rewriting the United Nations Declaration of Human Rights in language appropriate for eighth grade and applying their definitions to a case study of apartheid in South Africa. Stage Three required students to prepare a research paper on the human rights violations in one of the five countries. Finally, in Stage Four, the students were asked to design a museum exhibit for a Human Rights Fair that offered an in-depth look at current human rights violations in their assigned country. The final exhibit could be digital or analog, but the laptop computers must have been used to mediate the creation of the exhibit. For example, the exhibit may have been a poster, but pictures acquired from the Internet and text generated in a word processor would be integrated. Students worked independently throughout the unit; however, collaborations were embedded throughout for peer reviews, brainstorming, and reflections.

Throughout the ten-week unit, the students referred to the WebQuest site co-created by the teacher and researcher. Resources, such as CIA World Fact Book Web site and Internet links to newspapers produced in the countries under study, were provided to the students to reduce searches and information seeking. Scaffolds, such as a physical and human geographies spreadsheet, electronic note card template, guiding questions, brainstorm sheets, peer evaluation forms and Internet bibliographic links, were developed to support the students in their project-based learning approach. In many instances, the teacher and researcher were resources and scaffolds throughout the WebQuest. On a number of occasions the teacher invited the primary researcher to team teach the unit with her in order to aid the students in their process of learning and in the production of their computer-mediated learning artifacts.

**Table 1.** Elements of project-based learning for stages of geography and human rights unit.

| | Stages of Geography and Human Rights Unit | | | |
|---|---|---|---|---|
| **Elements** | **Stage 1: Physical & Human Geography Characteristics Grid (2 Weeks)** | **Stage 2: Defining Human & Civil Rights (2 Weeks)** | **Stage 3: Research Paper (4 Weeks)** | **Stage 4: Human Rights Exhibit (2 Weeks)** |
| Introduction | Since many of the violations of human rights are extended across the globe, it is difficult for students at our school and at other schools in our community to understand what is occurring in these countries and to grasp why these events are happening. You will create an exhibit to be displayed in a Human Rights Fair to be held just before Spring Break for your friends and younger students to experience. In order to create an authentic exhibit, you will construct a series of artifacts that represent elements of the violations on human rights. With these elements as background material, you will build an exhibit like you would experience in a museum about your specific human rights violation. | | | |
| Task | • Research & identify the physical and human geography characteristics for one of five countries | • Define, compare & contrast human and civil rights | • Describe the human rights violations in a chosen country in a research paper | • Design a museum exhibit about the human rights violations in the chosen country |
| Process or Investigation | • Research the five physical geography themes for this country: Location, Place, Human environment interaction, Regions, Movement. Also, research the human geography themes for this country: Government, Political issues, Religion, Ethnic groups, Current conflicts, Economic Issues | • Review UN Universal Declaration of Human Rights<br>• Create a list of human rights to share in class<br>• Contrast civil rights with human rights | • Research the human rights violations facing the chosen country today. | • Brainstorm the qualities of interesting, poor, emotionally evocative exhibits<br>• Describe the goal & features of the exhibit<br>• Construct exhibit |
| Resources | • WebQuest web pages<br>• WWW links, e.g. CIA World Factbook & US State Department Background Notes<br>• Link to class-compiled grid for all countries to aid discussion | • WebQuest web pages<br>• WWW links, e.g. UN Universal Declaration of Human Rights & first Civil Rights bill | • WebQuest web pages<br>• Electronic notecards<br>• WWW links to countries' information<br>• Peers & teacher<br>• Media Center<br>• Creating Works Cited page at Noodletools.com | • WebQuest web pages<br>• WWW link to existing museum exhibits<br>• Research paper<br>• First-hand fictional accounts<br>• Editorial/opinion documents |
| Scaffolding Mechanisms | • Microsoft *Word*® template to fill in researched information<br>• WebQuest web pages<br>• Guiding question | • Guiding questions<br>• WebQuest web pages & links | • Electronic notecards template<br>• Writing process guidelines<br>• Citing sources presentation WWW link<br>• Sample title page for download | • Brainstorming guide & in-class session<br>• Design form<br>• Checklist |
| Collaborations | • Participants worked with Table partner<br>• Compared and edited information with another pair in class | | • Peer conferences & edits<br>• Teacher conferences | • Peer review of design goals & preliminary exhibit |
| Reflection & Transfer | • Class discussion | • Class presentation & discussion | • First-hand fictional account<br>• Editorial/opinion document | • Human rights unit evaluation |

## *Participants*

Five students were selected for a detailed exploration of the research question. A criterion strategy (Miles & Huberman, 1994) was used to determine the sample. The criteria used to determine the participants were (a) a balance of gender, (b) diversity in country under study, (c) teacher recommendations and (d) those that consented to participate in the study. All the eighth grade students excelled at academic achievement.

The participants in this study selected pseudonyms at the beginning of the data collection, and these were used throughout all the data collection and the research report. The five eighth-grade participants for this study were:

*Allison* was a white female. She was 13 years old, and she was in Period 1. She had been at the day school for four years. She attended a public school prior to fifth grade. Allison investigated Kashmir, a region in India.

*Bob* was a white male. He was in Period 1, he was 14 years old, and he had been attending the day school for three years. Before that time, he attended a religious private school. Bob researched Sri Lanka.

*Brittney S*. was a white female. She was 14 years old and had been at the day school since she was three years old. Brittney S. was in Period 2, and she examined Sudan.

*Brittney T.* was a white female. She was 14 years old, and this was her first year at the day school. Before this year, she had attended a religious private school. She was in also in Period 1, and Brittney T. analyzed the human rights violations in Argentina.

*Brock* was an Asian male. He was 14 years old. He had been at the day school for two years, and he was in Period 4. Prior to attending the day school, Brock had attended a public school in South Korea. Brock also investigated Argentina.

## *Data Sources*

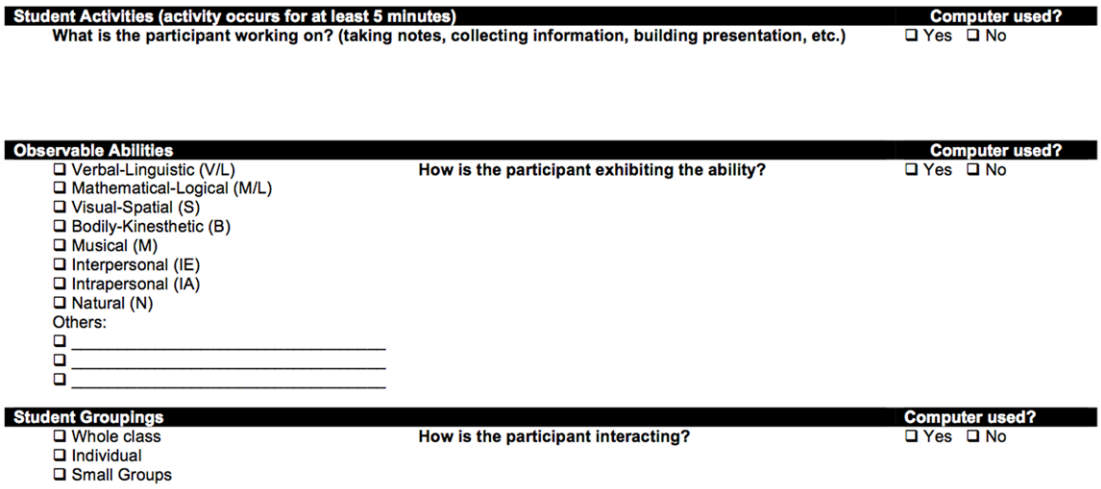
*Interviews.* Four rounds of interviews were conducted with each of the five participants: one at the beginning the human rights unit, two during the unit, and one at the conclusion to the unit. A semi-structured interview protocol was used with all five participants to allow variation in the order and phrasing of the questions, as well as probes to specific individuals (Patton, 1990). Each of the interviews lasted approximately 30 to 45 minutes in length, conducted during lunch period, a study period, or after school. Each was audio recorded then transcribed. Throughout the interviews, the participants were asked to chronicle and reflect on their project as it developed. On a number of occasions, the students were asked to reason what was impacting their projects and their learning, as well as their choices and uses of technology tools. For example, the participants discussed which scaffolds had been most helpful in the construction of their projects. Moreover, they articulated what they were learning and how this met, exceeded, or challenged their thinking. During the final interview, participants reflected on their completed museum

exhibit, their perceptions of how it represented what they had learned, and what their decision-making processes had been for choosing specific computer-based tools.

*Observations.* Throughout the ten-week unit, the participants were observed at least 3 times for approximately 50 minutes each. The researcher was a participant observer, contributing to the instruction at the request of the cooperating teacher. The purpose of the observations was descriptive information to supplement and complement the interview data. In addition, observational data were used as probes and referents in the interviews. The data collected during observations were useful in corroborating data collected during interviews. For example, when one participant described her discomfort with peer reviews, this was confirmed with observation notes describing little conversation between the participant and her review partner.

An observation protocol was used to aid in the collection and management of the data (see Figures 1 and 2). The protocol noted class activities that occurred for at least five minutes, as well as student groupings. Student activities, such as on-task/off-task behaviors, reading, writing, research, information seeking, discussion, etc. were noted every five minutes during a 50-minute class. Field notes were kept, including comments such as student-teacher interactions, student-student interactions, student-computer interactions and researcher impressions toward the students' processes, such as examples of questions asked of the teacher in developing their learning artifacts, interactions with other students, and computer skills.

**Figure 1.** Observation protocol for observer notes.



| **Student Activities (activity occurs for at least 5 minutes)** | | **Computer used?** |
|---|---|---|
| **What is the participant working on? (taking notes, collecting information, building presentation, etc.)** | | ❑ Yes ❑ No |
| **Observable Abilities** | | **Computer used?** |
| ❑ Verbal-Linguistic (V/L)<br>❑ Mathematical-Logical (M/L)<br>❑ Visual-Spatial (S)<br>❑ Bodily-Kinesthetic (B)<br>❑ Musical (M)<br>❑ Interpersonal (IE)<br>❑ Intrapersonal (IA)<br>❑ Natural (N)<br>Others:<br>❑ _____<br>❑ _____<br>❑ _____ | **How is the participant exhibiting the ability?** | ❑ Yes ❑ No |
| **Student Groupings** | | **Computer used?** |
| ❑ Whole class<br>❑ Individual<br>❑ Small Groups | **How is the participant interacting?** | ❑ Yes ❑ No |

**Figure 2.** Observation protocol for student activities.

| Student Activities | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0-5 | 6-10 | 11-15 | 16-20 | 21-25 | 26-30 | 31-35 | 36-40 | 41-45 | 46-50 |
| On-task | | | | | | | | | | |
| Off-task | | | | | | | | | | |
| Reading | | | | | | | | | | |
| Writing | | | | | | | | | | |
| Completing Worksheets | | | | | | | | | | |
| Note taking | | | | | | | | | | |
| Research | | | | | | | | | | |
| Information Seeking | | | | | | | | | | |
| Data Analysis | | | | | | | | | | |
| Problem Solving | | | | | | | | | | |
| Project-based Work | | | | | | | | | | |
| Delivering Presentations | | | | | | | | | | |
| Assessment | | | | | | | | | | |
| Discussion | | | | | | | | | | |
| Review | | | | | | | | | | |
| Other: | | | | | | | | | | |
| Other: | | | | | | | | | | |

*Artifacts.* At the end of the research paper and the museum exhibit stages, these participant-generated artifacts and documents were collected. The museum exhibits were used as referents and reflection aids in the final interview. Photographs or computer screen captures of these exhibits were taken and examined during data analysis. The photographs and screen captures were helpful in corroborating the participants' interview transcripts. As the participants described their experiences during the project and the technology tools they used, they were able to point to examples in their exhibits.

## *Data Analysis*

Analysis of the data followed a constant comparative method (Glaser & Strauss, 1967). The codes used to analyze the data were generated from reviews of the transcripts and the literature review. Data for each participant was coded separately. Iterative rounds of data reduction began with open coding directly from the interview, observational, and artifactual data transcripts. Example codes included: *subjects* defined as school subjects or classes; and computers make things easier as a code for descriptions of how the computer eased project creation. Second, a priori codes, such as *scaffolding* and *reflection,* collected from the literature were applied to the data. Next, demographic codes, such as *gender*, and research management codes, such as *Interview1*, were applied. These coding

categories were reviewed, refined and discarded as necessary.

Patterns in the codes were combined into categories as abstractions of the data (Merriam, 1998). For example, one category named *defining projects* collapsed *autonomy*, *grades*, and *projects are fun* codes as a definition of how the participants began to define project-based learning. Descriptions of the categories were developed. Lastly, with a faculty colleague, peer review and revisions abstracted the patterns into broader themes, such as *internal influences*. Themes represented recurrent patterns and codes across all the participants. All data organization and analysis was managed through QSR N6.

### *Rigor and Trustworthiness*

A number of strategies were used to ensure trustworthiness of the data and findings. First, the use of multiple sources of data collection (i.e., interviews, observations, artifacts) helped to triangulate the data and to confirm the findings and interpretations. Second, repeated observations over time were also used (Merriam, 1998). Next, member checking (Cresswell, 2003; Merriam, 1998) was conducted with the students to discuss the themes, confirming the accuracy of the students' voices. Results indicated a high level of researcher-participant agreement. Recommendations from each participant were noted and revisions or additions were made as necessary. In addition, the results were discussed with the eighth grade teachers to ensure accuracy in representing the students. Finally, an audit trail was maintained to collect decision-making, notes, and coding strategies.

## Findings and Interpretations

Given the intimate nature of results and interpretations in qualitative research, these are presented together below. From this study, five themes emerged to describe what influenced the learners' project work and learning: (1) internal influences, (2) external influences, (3) beliefs about projects, (4) tools for technology-rich environments, and (5) learning outcomes and products. Each of these is discussed below. Quotations are verbatim comments, and they are uncorrected to represent most accurately the voice of the eighth grade participants.

### *Theme One: Internal Influences*

The participants made decisions about their individual abilities, their work, and their learning artifacts. These decisions were based on personal analyses and evaluations of (a) their abilities, (b) their persistence and motivations and (c) the amount of effort the tasks would require.

Our previous research (in Grant & Branch, 2005) reported how projects reflected the individual's abilities. It is expected then that this evaluative process would be embedded within their internal influences as well. The participants had not considered their strengths and weaknesses before. Participants' evaluations of their abilities were invisible processes. For examples, when asked about their abilities and how they were represented in their projects, two participants responded:

> Allison: *Probably part of it is just that's who I am. So when I do a project like that … that's my tendency … 'cause that's what I'm good at.*
>
> Brittney S.: *So I think your abilities will kind of show up in the strengths of whatever you're doing.*

While the participants were aware of school subjects they were "good at," they had not considered how this might impact a project with which they were working. They also seemed to be unaware that they were making decisions about abilities to employ with projects and schoolwork in general.

Persistence, or the motivation and drive to follow a task through to the end, also seemed to contribute to their internal influences. Project-based learning affords flexibility in interests and the construction of personally meaningful artifacts in order to encourage positive motivations and ownership (Helle et al, 2006). Elements of motivational theory may be integrated into project-based learning, such as choice of content and learning, control for learning, and decisions and challenges to maintain interest (Dembo & Eaton, 2000; Turner & Paris, 1995). The participants' feelings about the duration of the project and the level of engagement of the activities seemed to affect the learning artifacts. Bob and Brittney S. described their levels of engagement and persistence to complete the project as:

> Bob: *All of the steps and everything … it seemed like it was repeating itself and the same thing over and over. Like Human Rights-Civil Rights, I think we got the point awhile back, but it was just like drawn out.*
>
> Researcher: *So, what did you enjoy about completing your project?*
>
> Brittney S.: *That when I realized I was done—that it felt really good just to be done with it.*
>
> Researcher: *What did you not enjoy about completing the project?*

Brittney S.: *It just took a really long time. We had been working on it really long,* and *then I just had to do the poster and stuff. Just when is this going to be over?*

Researcher: *So, it sounds like you were a little burnt out on it?*

Brittney S.: *Yeah.*

It was obvious from the participants' reactions the length of the project was too long. In addition, the participants felt that their learning about human rights and geography had ended prior to the end of the project. Admittedly, this was a long project. It was also new to the geography teacher, so it was difficult for us to determine exactly what length was optimal. The instructional design focused on the learning goals for the geography content. However, the value to the students was lost prior to the conclusion of the unit.

Comparable with persistence and motivation, self-management skills were evident in this study. The participants planned, organized, and managed their resources and their learning with varying degrees of success. For example, Bob explained how he planned his research paper:

> *Uh, my papers kind of like go, you know, one, two, three. Nice and like, neat. I don't like to skip around to topics because it makes the paper more confusing. So that's just how I do it. I just do, you know, intro, leading up to present, and conclusion*.

Brittney S., however, reflected on how she came to understand her biases:

> *Sometimes, I found some biased information, but I can usually identify that. Because it doesn't really affect my paper that much, because seeing other people's point of views opens me up to other ideas like, "Well, I've always thought this, but what they're saying is kind of true too." So, it makes me a little more biased toward my beliefs.*

The participants were also frustrated with the amount of information—and sometimes lack of information and resources to aid them. For example, during observations in class, it was evident the participants struggled with synthesizing the information from the different Internet resources hyperlinked on the WebQuest site. With primarily didactic teaching and learning experiences, the participants were not experienced with the open-ended nature of the project, possibly diminishing the quality and expectations for self-direction and self-regulation required. This is consistent with research on constructivist and student-centered learning environments, where the learners are expected to experience ambiguity and cognitive disequilibrium (Applefield, Huber, & Moallem, 2000;

Barrows & Tamblyn, 1980; Savery, 2006). It is also consistent with research on adolescents as they struggle to manage methods of learning and their academic performance (Lave, 1988).

Another internal influence for the participants was their perceptions of transfer. The participants seemed to segment their abilities and learning into the activities and disciplines with which they were associated. For example, when I asked Bob why he didn't use his other strengths, such as science and math, in his geography project, he replied:

> *Because they weren't needed. I don't think I needed math or science in a geography report. You use some of those building abilities that's for something that is not so factual. For a factual report, it is like doing a newspaper article or something.*

Similarly, Allison had difficulty in conceptualizing how other disciplines such as math, and abilities such as athletics, she excelled in could be used in her geography projects. She said:

> *I don't really know how to answer, maybe just because athletics don't have anything to do with geography or that topic? Math? The same, I guess. It doesn't really involve as much. I mean there are statistics in my paper, which I guess is math kind of.*

Brock's experiences were similar. He was unable to connect logic and math to geography. During an interview, I asked Brock how he determined the structure for his research. He said, "From most important to least important." Brock never made the connection that he was performing problem solving and logical skills during the Human Rights unit in Geography class. In another interview, Brock explained:

> Brock: *My abilities were thinking things. It doesn't have anything to do with that.*
>
> Researcher: *Why not?*
>
> Brock: *Well, my abilities are a lot like solving things with Math. And this has nothing to do with thinking.*

Researchers have suggested content and skills are over-contextualized when taught in a single context, class, or discipline (de Graaf & Kolmos, 2003; Cognition and Technology Group at Vanderbilt, 1983; Lave, 1997). Gick and Holyoak (1983) reported when subjects are taught in multiple contexts, individuals are more likely to abstract the relevant concepts. The participants in this study seemed to have compartmentalized their learning and their abilities. Elliott, Hufton and Hildreth (1999) have suggested instruction include opportunities for learners to develop models and flexible representa-

tions of knowledge to promote wide transfer of learning and skills. While it was obvious to the teacher and me how the projects were multi-disciplinary, this fact escaped the students. So, the participants made few connections across their courses.

Finally, the perceptions of the amount of effort that tasks in each phase of the project would require also influenced the projects. The participants evaluated the tasks, determining which methods and resources might be less rigorous and less time consuming. Decisions about what was "easy to do" or the amount of work a task demanded shaped how the eighth graders progressed.

> Allison: *I think [a computer] makes everything easier and faster. I can't think of anything it makes harder. You can go on the Internet and do your bibliography.*
>
> Bob: *I figured, it was easier than most other ways like: Who? What? When? Where? Why? And, uh, most of my note cards were in that order.*
>
> Brittney T.: *I think it's easier to just like do little bits of things at a time. I did a poster and then I did a PowerPoint stuff and that was like a lot of work and then one of my other friends did like a ball and (Did you see hers?) … and it wouldn't have taken as much work to do that.*
>
> Brock: *'Cause [electronic notecards] were easier than, um, writing the information. I can just copy and paste it. That was easy. 'Cause it's, it's easy to write. It's easy to decorate.*

So the participants chose tasks that were "easier," "faster," and required less work. This preoccupation with less rigorous activities may seem inconsistent with other research on American adolescents' views of effort (cf., Brush & Saye, 2000). One possible reason for the participants' views on effort could be attributed to balancing effort with other internal influences, such as motivation, and other external influences (to be discussed next), such as technology tools and access to resources. Barab et al. (2000) caution that learners may experience cognitive overload when they are unaccustomed to a resource-rich environment.

### *Theme Two: External Influences*

The previous theme centered on elements within the individual. This theme looks outside the individual to factors that are external. These included (a) the teacher, (b) grades, (c) time and (d) logistics.

One of the primary influences that is external to the individual but critical to the learning environment is the teacher. Other researchers (e.g., Brush & Saye, 2000; Dembo

& Eaton, 2000) have reported that lack of teacher engagement has negatively impacted the learning environment. The role of teacher-as-facilitator in project-based learning environments is difficult (Bickford, Tharp, McFarling, & Beglau, 2002; Ertmer & Simons, 2006; Grant & Hill, 2006), particularly as teachers are encouraging students to take responsibility for their learning. The participants described their teacher's influence as a guide for the content and as a scaffold.

> Allison: *Well, it was pretty much outlined by [our geography teacher] ... [Our geography teacher] has helped a lot writing it ... Like I'll ask her questions about "is this — are these kinds of facts okay? Is this what you want the paper to be like? Is this sentence a good sentence?" And whether she thinks it's a good thesis statement. And in general answering questions about my topic. Like I'll ask her which side do you think has done more things to the Kashmiri people or which side is the worst side? I thought the website was fairly helpful.…However, I rarely used it unless told to in class.*

> Brittney S.: *When I chose my country, the things [our geography teacher] had summarized to us about the countries kind of made me want to learn more about it.*

> Brock: *At first, [our geography teacher] told me what I needed to, what my exhibit has to had, so I found the details that she told me.*

Ertmer and Simons (2006) assert that when teachers become frustrated, they may "revert back to their teacher-directed strategies" (p. 44). In this study, the teacher's unmistakably visible role influenced the learning and learning artifacts. Savery (2006) suggests that teachers define the parameters of a project, so learners have to negotiate boundaries less. While project-based learning emphasizes teacher-as-facilitator, this label may do an injustice to the complexity of teaching. In fact, it may underestimate the teacher's role and ability to determine when it is appropriate to use more directive methods within a project-based unit. Like Ertmer and Simons, Clark (2006) asserts that in these instances, teachers may be accommodating project-based learning into their existing didactic pedagogical beliefs, making little substantive change away from didactic methods.

Grades are noticed even in classrooms where the learners are engaged in learning. The participants' perceptions of what is expected to achieve "good grades" affected their learning products. These perceptions were often discussed with respect to projects and in comparison with tests. For example:

> Bob: *With the project for a grade, it's, you know, you have a set thing you have to do. It's like you have to do a paper and a poster and present it to the class or*

> *something. Like we had the freedom of how we wanted to do it, the big thing and the PowerPoint. The paper, we had the freedom of how we wanted to do it, but when she actually started grading, it looked like she graded the way she wanted to grade on, like if you did a poster board—just a poster board—I don't think she would have graded you as well unless it was good as like if you had done a PowerPoint and a poster board and all that information and ways of presenting it.*

> Brittney T.: *You just have more freedom to put whatever you want on there. And you don't have to worry if it's wrong or not …. Like if you don't have it in the correct format or just like, if you have like extra bits of information that don't really like relate to your topic, it won't be counted off, probably.*

> Brock: *And she took off a point about effort. I didn't understand it.*

> Allison: *At first I wanted to have a thing that surrounded you almost like a room but then I realized that—I mean, I could do something like that and get just as much—[emphasis added].*

So the participants believed grades were external to their control: Grades were the domain of the teacher. Their primarily didactic experiences may have led to this belief.

Time was also considered to be a factor in the decisions the participants made. Time in this study was often discussed with other internal influences, such as effort and motivation, and external factors, such as grades. Two participants responded:

> Bob: *I actually like when projects take a long time, because you have more time to do them. You might have to get more information, but it's better than doing a bunch of little ones.*

> Brittney S.: *[This project] just took a really long time. We had been working on it really long, and then I just had to do the poster and stuff. Just, when is this going to be over? I got a high B, which isn't bad. But if I had spent a little more time on it, I could have gotten an A. When, I pretty much enjoy everything about [projects], except when they go slow and it takes a long time. 'Cause you expect them to be fast and I get impatient.*

While time management may be academically regarded as an internal influence, the participants regarded time as external to themselves, considering it something they also had little control over. Dembo and Eaton (2001) suggest difficulties with time management for adolescents as a conflict between academic goals and nonacademic

(e.g., personal or social) goals. This external view may be derived from the schedule the teacher and researcher co-constructed to scaffold student performance in the project-based learning. Project schedules are recommended to help students monitor progress (Hunaiti, Grimaldi, Goven, Mootanah & Martin, 2010; Wang, 2009). So, the scaffolding we included may have denied students' negotiations with self-direction.

Finally, other more logistical considerations influenced the participants' learning products. What was possible or what the participants had planned was sometimes modified because of practical reasons. The exhibits for the human rights fair were adjusted based on these decisions. For example, Allison and Bob discussed how their projects had evolved.

> Allison: *Well, when we first got assigned the project, I talked to my dad about it for awhile, just because, in case he needed to help me with any of the building or anything of it. Because the first thing I wanted to do was like a stall and it had a curtain and you walked into it and you're surrounded with pictures and things about it. But then I decided that was a little bit over-scaled and that was going to be really hard to do. So I kind of scaled it down to just having the tri-folds half way around. And I guess the tri-fold board idea was kind of a surrounding thing, but it was easier to do it with a tri-fold board because they fold around easier. And I also used it on a science fair project when I was younger, so I'm used to using those boards.*

Although no specific requirements were given about the final human right project, Bob originally felt compelled "to like make a board" to accompany his electronic slideshow. However, he changed his mind because of problems he encountered. He said his project changed,

> *Because glue got everywhere and everything, so it didn't work too well. So, I just stuck with PowerPoint. And I didn't make a good a grade on it as I thought I would have.*

Practical matters shifted the course of the participants' exhibits. These logistical considerations were weighed against the other external influences, such as time and grades, and the other internal influences as well.

### *Theme Three: Beliefs about Projects*

How the participants defined projects also influenced their learning artifacts. This definition was based on their previous experiences with projects. The intangible characteristics of projects, according to the students, were: projects could be fun and engaging and projects could offer freedom and autonomy, but these positive aspects were sobered by

their previous and current teachers' expectations. Allison, Bob, Brittney S. and Brittney T. described these characteristics as:

> Allison: *I like projects, I guess, because it's more fun than regular class work to be able to put something together on your own.*
>
> Bob: *We had the freedom of how we wanted to do it, the [museum exhibit], and the PowerPoint.*
>
> Brittney S.: *[The exhibit] was kind of a fun thing to do. After all that research, to kind of make it into kind of like a fun thing other than a research paper kind of to show everyone else.*
>
> Brittney S.: *Because you actually get involved with it and you are doing something with the information, not just repeating it down on paper.*
>
> Brittney T.: Y*ou just have more freedom to put whatever you want on there. And you don't have to worry if it's wrong or not.*

The participants seemed to grasp the motivational elements, self-direction and autonomy that are consistent with the theoretical tenets of project-based learning. So, conceptually, the participants understood the value of the project.

In comparison, concrete qualities of projects were also based on previous and current experiences. The participants believed projects were "colorful," included pictures and images, involved the audience and often included a display "board." During the unit on human rights, no examples of exhibits were given. One class period, however, was spent discussing existing museum exhibits and what the participants and their classmates liked and disliked about exhibits they had visited. But again, the participants' prior experiences defined what a project was. This was particularly true when they felt they had "to do a board," that is, a corrugated tri-fold display board.

> Allison: *I knew I wanted to do a lot of pictures and bright colors, because that's what I liked about existing exhibits, and I knew it would be a lot more interesting for somebody to look at if it had a lot of pictures and things that they can look at instead of just reading.*
>
> Bob: *When we go to PowerPoint, I like to include pictures and stuff. When I do a web site, pictures and stuff.*

> Bob: *Having to like make a board because— [pause] trying to do something I didn't really want to do that much.*

> Brittney S.: *I usually just like to make it colorful and try to catch people's eyes to make them want to read it.*

Grades helped define what projects included, too. The participants held beliefs that projects were less rigorous. As Brock said, "Usually, project grades are like test grades. So, it's much easier to get a good grade." This was interpreted to mean that projects were weighted in their course grades similar to the weight tests held. Because of the many elements that were embedded in projects (defined by the teacher, researcher, and the participants themselves), including effort and aesthetics, Brock felt it was easier to perform at a higher level than strictly on the accuracy of an objective assessment. This may be in part derived from the enjoyment and freedoms the participants associated with projects. Brittney T. echoed Brock's sentiment. She said:

> *Well, I think I kind of like...you know, not being tested over it because you won't get like a really bad grade unless you don't work on a project at all. Then if you learn the stuff that you are supposed to, and you get all of your information, they will probably get a good grade."*

Bob agreed with Brock and Brittney T., but he felt there was a dichotomy:

> *I categorize two different kinds of project. There's a fun project and there's, uh, there's a project for a grade. A project for a grade is something you'd write a paper or a report. A fun project is something you do on PowerPoint and you can have pictures and stuff. And you can do animation and be more creative. With the project for a grade, it's, you know, you have a set thing you have to do. It's like you have to do a paper and a poster and present it to the class or something*

As Brock mentioned above, projects were also compared and contrasted with tests. To the participants, tests were for the teacher. The teacher tested to determine whether students knew information. Projects were like tests in that they tested the participants, but they were different because they gave the participants an opportunity to use their knowledge in a variety of formats. I asked the participants if projects were like tests. They responded:

> Allison: *It was much better because [pause] I mean, you didn't have to study for it. You did have to work on it but it wasn't. [Pause] Since I liked to do this kind of stuff, it wasn't like studying or anything for me. I enjoyed putting it together and figuring out how I was going to do it so it wasn't near as bad as a test.*

> Bob: *I think in some ways, yes, because it's being graded, but you have the ability to do whatever type of project you want and there is no right answer. I mean, you have got to get facts down, the right facts. But the way you present it, there's no right answer. How well you work and like that.*
>
> Brittney S.: *Yeah, but I think it is different than a test because [pause] you— like in a test you just memorize information. But this you actually learn it and you teach it to other people. So, I feel like in a different way it is different from memorizing it.*
>
> Brock: *This project is like a test because] it took a long time and the teacher had pressure on it. It had pressure to finish, and I think it was hard to finish it.*

When defining projects, on the whole, the participants seemed to understand that the project-based learning was a vehicle for them to demonstrate their learning. They understood projects afforded them an opportunity to demonstrate their knowledge differently than tests. There was also a small amount of evidence to suggest the participants perceived that projects support multiple representations of knowledge. For example, Bob noted that the project allowed him to determine "the way you present it." Helle et al. (2006) assert that project-based learning affords use and creation of "multiple forms of representation" (p. 293), allowing students to integrate different forms of knowledge (i.e., textual, pictoral, abstract, concrete). So, the participants seemed to understand the scope and purpose of project-based learning, but some still perceived it as less meaningful than the didactic teaching to which they were accustomed.

### *Theme Four: Tools for Technology-rich Environments*

The design of the learning environment by the cooperating teacher and researcher sought to take advantage of the technology-rich environment of the day school. The resources available to the participants, including productivity tools, scaffolds and collaborations, were used and valued to different degrees by the participants. The resources used in this environment to a large degree were consolidated in hyperlink lists to reduce searching; they were developed to scaffold the learners beyond their current skills. For example, an electronic notecards template was provided during the research paper stage, and a brainstorming guide was available at the beginning of the exhibit stage. Other guides promoted collaborations and sharing of information and critiques, such as a peer review checklist during the research paper and exhibit stages.

The technology-rich environment also relied on ubiquitous computing available to the participants. The students did not use the computers to extend their thinking, though. Instead, the computers were used as a tool for productivity. Allison, Brittney S., and Brittney T. said:

Allison: *[Computers] made it a lot easier because I didn't use my laptop as much as I used my home computer. But I had my research on the laptop so I could just take little pieces of it and load them on here instead of having to rewrite something. It looks a lot neater because I typed everything instead of having it handwritten. I could find my pictures on the Internet and blow them up and resize them.*

Brittney S.: *I think that they're good, because they make a lot of shortcut[s]. You don't have to go check out books or find, you can just type something in and it does it for you.*

Brittney T.: *It was easier to just copy and paste different things. It's just easier, because it goes faster on the computer.*

Brittney T.: *It looks neater when you print stuff out of the printer instead of hand writing it. And it was a lot easier, and I couldn't have done those PowerPoints without it.*

The participants relied on their laptop computers to accomplish their tasks for this unit on human rights. During this unit, the school's network crashed; it remained unavailable for over a week. As Brock explained, the only negative he had about computers was "when the Internet server was down." Other technical problems associated with their computers punctuated the participants' dependence on their computers. Bob, Brittney S. and Brittney T., for example, explained their frustrations.

Bob: *When I'm doing projects and sometimes the computer will shut [down] …. It's only happened like once or twice, but it's really annoying.*

Bob: *Sometimes [the laptop computers are] really slow. And when they freeze up. Because I'll get frustrated with the computer and especially these laptops. 'Cause my laptop, the screen broke, and I have to go through and clean out the disk space.*

Brittney S.: *I pretty much enjoy everything about [our laptops], except when they go slow and it takes a long time, 'cause you expect them to be fast and I get impatient.*

Brittney S.: *We've had some problems getting information, and the Internet has been down, and that's kind of been frustrating.*

Brittney T.: *They freeze, then you can lose your work and all that stuff.*

Brock also made explicit decisions about his exhibit based on his available resources. In fact, the resources—namely his laptop computer and the software installed on his computer— were the most noticeable in his exhibit. Brock wanted to use his computer for his exhibit and could not see another way to do so other than a web page and electronic presentations. He said, "I thought it was only way to do on my laptop. Yeah, so I made PowerPoint." So Brock didn't consider any other path to complete his project. Indicative of all the participants, Brock was dependent on the technology. It shaped his decision-making about what could and should be included in his project.

### *Theme Five: Learning Outcomes and Products*

The previous four themes centered on influences. This final theme represents what is shaped by these influences. As we considered what had been learned during the project-based learning, it became clear to us that the learning outcomes and learning products were more complex than just the artifacts produced. The participants' internal and external influences, their beliefs about projects, and their uses of technology tools directly impacted their learning outcomes and learning products. Grant and Branch (2005) argued that learning artifacts may not represent all the learning that occurred by participants. Parsons (1998) describes the limits of assessing and recognizing the concrete examples of learning. He says, "Educators today are challenged to find ways for students of diverse abilities, cultures and ways of knowing to express learning, much of which is not confinable to a 'product' " (p. 29). Therefore, learning outcomes and products were defined as the formal and informal learning that is and is not reflected in the learning artifacts. In other words, the products of learning are both the planned learning represented in the tangible artifact and the unplanned, or incidental, learning acquired during the unit that may not be reflected in the artifact. This most closely aligns with the hybrid project-based/problem-based approach Prince and Felder (2006) describe, where product and process are both emphasized.

The primary objective for this unit was to analyze, evaluate, and synthesize current human rights violations in countries from around the world into a research paper and museum exhibit. This was achieved by the participants' abilities to communicate their understandings of the situations in their respective countries. The exhibits produced by the participants exposed these inhumanities well. Their research papers and exhibits covered complex issues such as religious beliefs and anti-Semitism, economies, and governments, along with murder, torture and existing slavery. Allison summarized her learning process, and her learning was indicative of the other participants. She explained:

> *[My project] shows how we learned it, because the way I did my project is a little bit like—Like when we learned about human rights in general and what they were, and then we got a little bit more specific about learning information about the*

> *countries and looking at maps of countries and doing tables that were just kind of an outline of what happened. And then we wrote our own personal accounts of what happened and we read stories about people that were there, so I guess it kind of goes like what we learned in the class.*

> *I learned how the [pause] people are affected …. I kind of saw both sides of the story about the people who are violating human rights and the people that are having the rights violated….I think I may have gotten even more out of it, because …. who I thought was the main bad guy. I guess, like Pakistan or India? And so I got a lot out of it, because I did get to read both sides of the story and see what happens: Why people start doing these kinds of things, instead of just what human rights are and how bad it is. Instead, why people commit these happenings or how they get so much hate built up…. I just thought about it more, because I am so used to [pause] when I think about something like that, like a conflict, one country being right or one country being wrong [pause] and I guess I thought well, it must be the same. But really it wasn't. I mean, it was just kind of both countries hated each other so much.*

The participants certainly met the learning goals for the unit on human rights and geography. They also acquired individual knowledge—knowledge different from the other participants—since they were researching different countries. The students also learned to different depths and breadths based on their own investigations. So, the open-ended nature and constructivist foundation of project-based learning were both met with the curricular goals of the unit.

Affective goals were also reached. The national curriculum standards for social studies (National Council for Social Studies, 1994) expect middle schoolers to explore different cultures, analyze human behavior with respect to geography and culture, and "become aware of and are affected by events on a global scale" (Global Connections section, para. 3). During reflection, the participants expressed their appreciation for freedoms and security they have in the United States. Brittney S. and Brittney T. commented:

> Brittney S.: *I [pause] learned to draw pictures of the people who lived in Sudan, and it really let me see kind of, get a better understanding of what they were really going through and it made me feel like—realize how lucky I was that I didn't have to experience my human rights being violated every day of my life.*

> Brittney T.: *It was an eye-opener and a lot of stuff about Argentina …. Just like about [pause] the economy and the way they treat people.*

Along with coming to understand the human rights violations individuals face in

their respective countries, the participants developed emotional bridges with these countries. The compassion the participants expressed regarding their countries was remarkable. These changes in thinking were accentuated in the stories Allison, Brittney S., and Brittney T. authored; see for example, Brittney S.'s first-person narrative in Figure 3. Allison explained the purpose of her story:

> *I just kind of thought that the first-hand accounts would be really neat to do because the people can learn a lot of stuff about Kashmir, but they might not really know what it's like to be there. But if they read the first-hand accounts…then it's almost as if they actually get put in somebody's shoes that lives there. So that's how they can really learn about it…instead of just learning facts it's usually more personal for someone to actually learn about a specific person that lives there instead of just what's happening there.*

The participants expressed empathy for the victims of human right violations in their respective countries. Brittney S. and Brittney T. were both moved by the connection they felt to the victims. So, project-based learning can achieve affective learning goals while accomplishing cognitive goals.

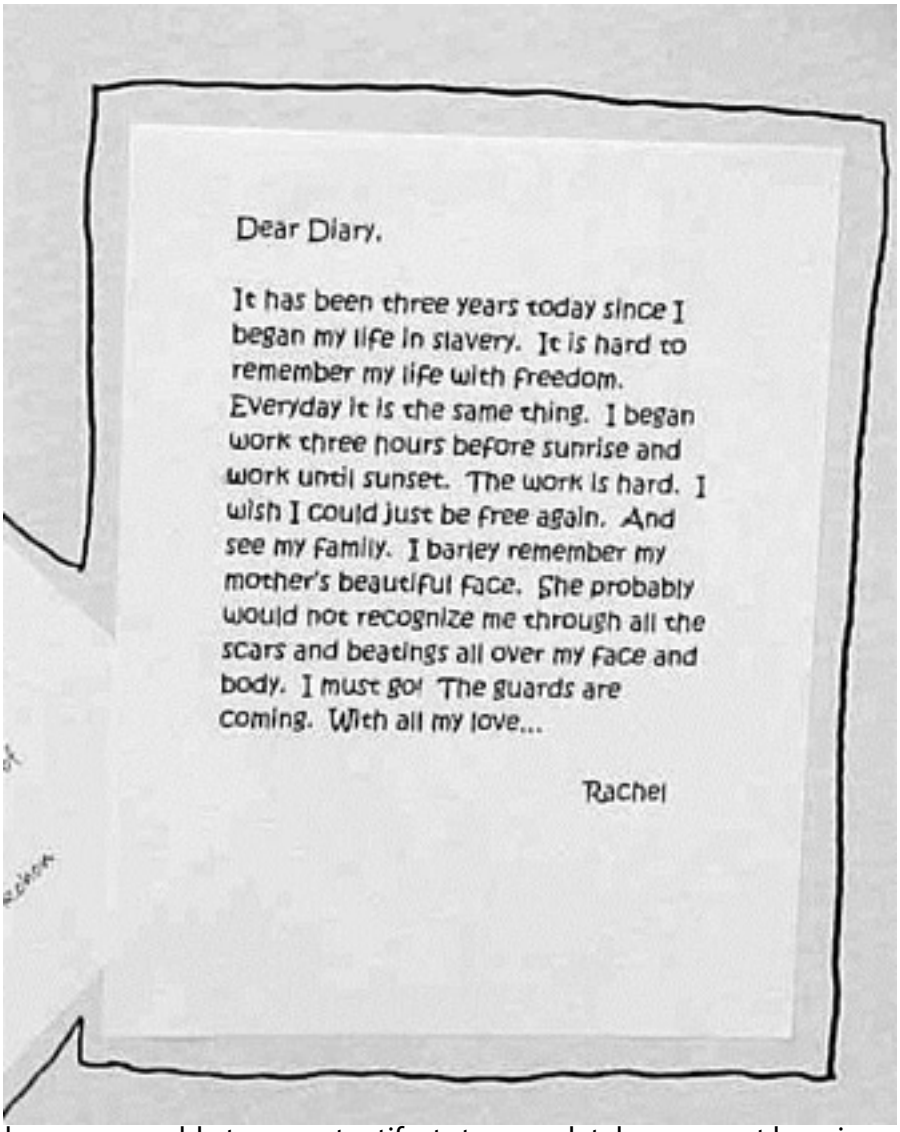
Some student decision-making was not evident in the learning artifacts and was invisible to the classroom teacher. Bob used his own impressions of visiting the Human Rights Fair to determine what his exhibit project should include. He indicated how his museum exhibit reflected his thinking:

> *I think you have got to think what people are going to want to see, if they are going want to have lots of pictures or lots of words…you'll probably not want to have lots of words because you don't want to be reading about Sri Lanka, a country that they've never heard of. And if that happens, they don't know where it is.*

Bob also considered that if he were visiting the fair, he would not appreciate large amounts of text and instead would be drawn to images and pictures: "I did basically, you know, copied things I had on my paper and changed them a little, shortened them, and like put them into categories." Unfortunately, the geography teacher was unaware of this decision-making and marked him down in his grade for lack of details. So, aspects of the learning went unnoticed by the teacher.

Some of the learning that occurred during the project-based learning unit was reflected in the learning products, or artifacts, such as the problems faced in the countries under study evidenced in the research papers and the plights of individuals written into first-person accounts in the participants' exhibits. However, other learning, such as Allison's struggle with which of the combatants was "right" and "wrong" and Bob's considerations for visitors to his exhibit, were not overt in their projects or went undetected by the teacher.

**Figure 3.** First person narrative from Brittney S.'s museum exhibit.




So, it may be unreasonable to expect artifacts to completely represent learning.

## Implications for Practice and Research

As with all qualitative research, the extent to which the findings can be applied in other contexts is situated with the reader, and the small sample size limit generalizability. The implications of this study are significant to inservice and preservice teachers, teacher educators, and other educational researchers.

### *Teachers and Teacher Educators*

This research presented the voices of five eighth graders as they moved through a unit on

human rights. The voices of learners are sometimes lost in the preparation of lesson plans. The internal and external influences the participants spoke of in this study highlight the challenges these individuals faced. Though the environment included elements of motivational theory, the duration of the project may have been too long for the participants. Bob, Brittney S., and Brittney T. made remarks about being "burnt out" on the topic. Bob felt the content became redundant, which could be attributed to how the participants repurposed their research papers into museum exhibits. In an effort to allow the students to represent their learning in multiple ways (i.e., the research paper, museum exhibit), we made an assumption that learning may occur differently between the two projects. Instead, the participants' learning may not have been advanced through the museum exhibit project. They may have just used other means to represent their learning, but their learning may not have been extended.

Teachers should consider varying the length of projects to determine the appropriate duration for their students. It may also be helpful for teachers to modify the length of projects in order for students to experience different project durations. Bob commented that this was the longest project he had worked on. "Longer than the Civil War…in seventh grade," he said. If teachers want to include in-depth investigations over an extended period of time, then additional research is needed for teachers in order to support the internal influences learners grapple with such as motivations, self-management and evaluation of effort.

Possibly the most consequential result from this study for preservice and inservice teachers is the influence the classroom teacher had on the participants. In this study, the participants reported that the teacher shaped which resources they used, which content they pursued, and to some extent, which elements were included in their learning artifacts. While the project-based learning afforded the participants choice, challenge and control of content, resources and types of artifacts, the participants relied on the teacher to guide their learning. I agree with Brush and Saye (2000): As teachers include more elements of learner-centered environments, additional research is needed on the changing teacher's role and ways to support learners as they take on more responsibilities for their learning. Previous literature suggested students contribute to the development of the grading rubric (e.g., Speck, 1998b; Stephens, 1996). One participant, Bob, felt the teacher used her own judgment to grade the exhibits, which was critical beyond the scope of the grading rubric. The expectations for "good grades" by the participants influenced the construction of their learning artifacts, and subsequently, their satisfaction with their learning and the experience. For Bob, both of these were low. The participants' experiences with primarily didactic instruction may certainly have contributed to these frustrations. More experience with project-based learning and more opportunities to participate in formative assessments (Helle et al., 2006) may improve the satisfaction and learning opportunities.

In addition, the participants relied heavily on their prior knowledge and experi-

ences, specifically (a) their beliefs about projects, (b) how projects were defined, (c) the concrete qualities of projects, and (d) the relationships among project, tests, and grades. So, teachers may need to be more explicit about the required elements of projects and those elements that can be original, unusual, or left to the learner's discretion. Teachers may want to be more explicit about transfer of knowledge and skills between disciplines and domains, such as math, science and social studies. While teachers and researchers may laude the interdisciplinary approach project-based learning allows, learners like the participants in this research may isolate knowledge and skills, over-contextualizing them to a specific domain. Moreover, teachers and teacher educators may need to reflect on why some students consider project-based learning to be less rigorous than examinations. Calling into question the academic integrity of project-based learning lends credence to Veermans et al.'s (2005) critique of using this approach in classrooms.

Designing a project-based learning environment can be difficult for teachers. Hill and Hannafin (2001) suggest learning environments that rely heavily on tools, resources, and scaffolds become more complicated the more closely they align with student-centered pedagogies, like project-based learning. For example, the participants valued the resources in this study to different degrees. Constructing scaffolds for students takes time, and the teacher is designing these supports in some cases "just in case" they are needed. So, it is possible that teachers may design scaffolds or aggregate resources that go unused, viewing this as wasted effort and time.

It is also important for teachers to undertake the challenge of including all the learning products, tangible and intangible elements, in assessment. As discussed earlier, it is possible that learning artifacts will not represent all the learning that has occurred during project-based learning. Both learning processes and learning products must be considered in assessments (e.g., Grant & Branch, 2005; Helle et al., 2006). Portfolios offer one alternative to capture many of the aspects of the learning process and the learning products. Arter and Spandel (1992) have described portfolios as "a purposeful collection of student work that exhibits to the student (and to others) the student's efforts, progress or achievement in (a) given area(s)" (p. 36). Parsons (1998) cautions that portfolios, while encouraging learners to be critical of their abilities and progress, may conflict with the teacher's authority and grading, may continue to limit potential artifact contributions, and may not work in all institutional settings.

Where learning artifacts are produced, increased emphasis needs to be placed on chronicling students' development processes. These are necessary to help record for the teacher process decisions that are difficult to detect and recognize (Land & Greene, 2000). The use of reflection to document learning process decisions and to provide details in portfolios can provide additional specifics to overt and less obvious learning products. Scardamalia and her colleagues (1989) have also worked to use intentional reflection and metacognition. This type of articulation of learning and learning strategies may sup-

port intangible elements acquired during the process of learning, as well as scaffold the self-direction and self-regulation with which the participants struggled. If teachers do in fact choose to use reflections to document process and decision-making, careful attention should be paid to project requirements, how the requirements are reflected in the grading rubric, how the requirements are evaluated within the reflections, and how the project requirements are communicated to the students. For example, Barak (2005) found that students explicated in their project documentations a systematic process whether they used one or not, because "the students believe[d] they [were] expected to work in a systematic manner" (p. 241). Again, teacher expectations and project requirements—whether explicit or implicit—can significantly impact how students craft projects, and subsequently, how student learning is assessed from projects.

### *Future Research*

Researchers can use this study as a springboard for additional investigations. This study was completed in a private school with a unique technology-rich environment interested in more student-centered pedagogy. It would be beneficial for subsequent research to explore how students in public schools create artifacts. These students may offer additional internal or external influences. For example, motivation toward schoolwork in general may be more prominent in public schools. Public schools may also offer a different perspective on the use of technology tools. The technology-rich environment in this study was unique with ubiquitous computing. This type of one-to-one computing environment is becoming more common in public schools, such as Michigan's "Freedom to Learn" initiative (McHale, 2006) and Maine's laptop program. Bickford et al. (2002) suggest technology can be an agent of change to move teachers away from didactic practices, so low cost computing such as the XO laptop, netbooks and iPods/iPhones may be catalysts with meaningful professional development.

This study involved eighth graders. Other case studies would be wise to consider a younger sample, where students have less experience with school norms, meaning their beliefs about projects may be less rigid. Also, an older sample may provide results where individuals may be able to direct more of their learning decisions. Additional research is also needed with other adolescents as they work within learner-centered environments. The current participants had few experiences with project-based learning, so other samples with similar, more and less experience would also be beneficial in understanding how to scaffold learners toward success in this environment. Meichenbaum and Biemiller (1998) offer a wealth of techniques to support learners in becoming self-directed.

Specific to project-based learning, additional research is also needed that includes self-directed techniques that are augmented with technological tools, scaffolds, and resources. Erickson and Leher (2000) have examined the role of hypermedia as cognitive tools in learner-centered environments. They also suggest further study with how students

represent their learning within hypermedia environments, such as web pages and electronic presentations. It would also be beneficial to understand how the design of learning environments influences learners' uses of specific tools, scaffolds, and resources. Additionally, more details are necessary to understand how learners and teachers reconcile grades, examinations, and projects. If project-based learning is to offer a valuable alternative to teacher-centered instruction, then the rigor of learning cannot be called into question.

## Conclusion

This research identified five themes as factors that influence how projects are created; yet its scope does not reach to explain the relationship(s) among these factors. In particular, the content itself—that is, human rights and geography—did not appear to significantly impact decisions the participants made. There are indications that students rarely weigh alternative solutions or gauge criteria for determining a solution (cf., Barak, 2005). Then, indeed, how do learners choose a path to complete a task? This research suggested participants considered the resources available to them, the amount of time it would take to complete the project, how difficult it would be to complete the project, how much effort was necessary to obtain a good grade, and whether the project met teacher expectations. While the participants met and exceeded the learning content expectations, none of their considerations directly related to the content.

The student participants may have considered learning the geography content a given, where the breadth and depth were determined by the teacher (c.f., Savery, 2006). Project-based learning attempts to relinquish these decisions to students. However these students' inexperience with project-based learning may have forced the teacher to be more directive with the content—even though the unit was planned differently. Digital scaffolds may need to be developed to aid students in self-regulation with the course content (e.g., Scardamalia et al., 1989) and to fade as students become more expert. This may give students who are inexperienced in a discipline additional support early on and diminish their support over time.

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**Michael M. Grant** is an associate professor in the Instructional Design and Technology program at the University of Memphis. He can be contacted at mgrant2@memphis.edu.