



## The Sustainable Building Field Trip – Real vs. Virtual

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Professor Orla Smyth LoPiccolo is a registered architect who joined the faculty of the Department of Architecture and Construction Management in September 2008. Prior to joining Farmingdale State College, LoPiccolo was an adjunct professor for the Department of Architecture and Design, New York Institute of Technology for five years. LoPiccolo received her undergraduate and professional degree with honors from Dublin Institute of Technology - Bolton Street College of Technology and Trinity College, the University of Dublin, Ireland, and her post-professional degree in Architecture Urban Regional Design from New York Institute of Technology. Subsequently LoPiccolo received a postgraduate diploma in Construction Management from New York University where she was awarded the Excellence in Academic Achievement Award. LoPiccolo has private sector architecture and project management experience in both Dublin, Ireland and on Long Island, NY, and she has over ten years of public sector experience as an architect and a Community Development Project Supervisor with the Town of Islip, NY. She is an active member of committees and groups at Farmingdale State College, including the Green Building Institute, Smart Grid Committee, Calendar Committee, Leadership, Governance and Administration Middle States Working Group Sub-Committee, Academic Working Group Committee for the college's Centennial Celebration, and an Orientation Faculty Leader. Off-campus, LoPiccolo has completed a three year term as the secretary and treasurer of American Society of Engineering Education (ASEE) Middle Atlantic Section and was recently elected as chair-elect of this section. In addition to her numerous presentations and publications on her research in teaching sustainable construction methods, and service learning, LoPiccolo has New York State Building and Energy Code certifications, Passive House consultant training, International Code Council (ICC) certifications Green Building, and Residential Energy, and Building Performance Institute (BPI) certifications Building Analyst Professional and Building Envelope Professional. LoPiccolo has researched and integrated sustainable construction techniques, service learning, student-built physical models, Autodesk Revit Architecture and field trips into her courses and she was as awarded a Title III Students First grant to introduce freshmen students to sustainable construction methods including Passive House design. LoPiccolo teaches Materials and Methods of Construction I, Graphics I, Graphics II, Construction Design, and Site Design and Construction.

## The Sustainable Building Field Trip – Real vs. Virtual

### Abstract:

When studying sustainable building techniques, the question arises: can virtual field trips be a substitute for real field trips? Field trips have long been used to supplement coursework, offer students firsthand knowledge and provide them an opportunity to gather data “in the field.” Albert Einstein said, “The only source of knowledge is experience.” Faculty routinely share their experience and knowledge with students through in-class activities such as lectures and discussions, but out-of-classroom activities such as field trips offer new dimensions in learning. By visiting a sustainable building, students can see sustainable construction techniques, building materials and equipment that may not be otherwise available to them. Students learning about the construction and design fields today need sustainable building knowledge. This is necessary to meet the increased public interest in saving money in building lifecycle costs, preserving the environment and meeting sustainable/energy conserving requirements as set by many permitting agencies and codes. Although there are increasing numbers of sustainable buildings completed and being built, a real field trip to one may not be an option. Factors such as the building’s proximity to the students’ campus, access to the building, cost of travel, and time constraints may be deterrents to going on a field trip to a sustainable building. An emerging alternate to the real field trip is the virtual field trip, where students can take a virtual tour of a sustainable building online and learn the information that would be given to participants on a real tour of the facility. The goal of this paper is to quantitatively examine students’ learning from a real field trip to the Queens Botanical Garden Visitor and Administrative Center, Flushing, New York, an award-winning, sustainable building, and compare it to students’ learning from a virtual field trip on the Queens Botanical Garden website. Two groups of Fall 2012 Architecture and Construction Management students were pre-tested on their knowledge of basic sustainable construction techniques found at the Visitor and Administrative Center sustainable building on the field trip, then either taken on a real field trip of the sustainable building or instructed to take a virtual tour of the same facility. Following their field trips, both groups of students were given the same post-test and their respective learning assessed and compared. Students were also given a qualitative survey to assess their assigned field trip type. The results of this study will provide faculty with an understanding of the relative benefits of integrating a field trip, real or virtual, into their courses.

### Introduction:

The goal of this paper is to examine if an interactive, computer-based, “virtual” field trip (non-avatar) can be as effective to student learning as a real field trip, and to discuss student participants’ perceptions of each model. A field trip, real or virtual, to an award-winning sustainable building was the chosen learning method to introduce 2 freshman Materials and Methods of Construction I classes to sustainable construction methods. Other reasons for this choice were to: link formal and informal learning<sup>1</sup>, add variety to instructional methods<sup>2</sup>, link theory to practice<sup>3</sup>, motivate student learning<sup>4</sup>, and optimize time. On a macro scale the following ABET accreditation student outcomes were supported by this field trip:

- “(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.
- (i) a recognition of the need for, and the ability to engage in life-long learning
  - (j) a knowledge of contemporary issues”<sup>5</sup>

On a micro scale, it was planned that the students would gain basic knowledge of a building with integrated design by viewing working examples of the following: the positioning of a building on its site to maximize passive solar gain, how recycled building materials can be used, and how the following “green” construction methods work: green roofs, composting toilets, permeable paving, biotopes, bioswales and “green” systems such as: geothermal rain water catchment, photovoltaic, solar thermal, and grey water. It was also anticipated that the field trip would encourage student-to-student and student-to-faculty interaction to advance a professional working environment created in the classroom.

## Background

Per Krepel and DuVall, a field trip is "a trip arranged by the school and undertaken for educational purposes, in which the students go to places where the materials of instruction may be observed and studied directly in their functional setting: for example, a trip to a factory, a city waterworks, a library, a museum etc."<sup>6</sup> Author and naturalist Henry David Thoreau is said to have formally invented the idea of a field trip with his brother after they founded an elementary school in 1838 in Massachusetts.<sup>7</sup> Prior to this date, however, and even before the first schools that are said to have been created by Plato (429–347 B.C.E.), children have visited and learned from places outside of their homes through their parents and/or through apprenticeships.<sup>8</sup>

## Actual Field Trips

Actual field trips have many benefits if they are directly linked to pedagogical goals and if there are clear objectives for going.<sup>9</sup> Field trips can introduce a topic or be the conclusion of a topic, they can “provide concrete sensory input and help students derive meaning from information.”<sup>10</sup> An Institute for Learning Innovation survey of 128 people who had been on a field trip many years prior found that 75% of what they recalled relate directly to the subject matter of the field trip.<sup>11</sup>

Actual field trips also have drawbacks. According to a survey by Krepel and DuVall, only 10% of teachers run field trips in a typical year.<sup>12</sup> Teachers give many reasons for not taking field trips. These reasons include lack of funding, potential liability, busy schedules, transportation issues, a shortage of planning time,<sup>13</sup> and financial burdens to students and their families. Other reasons given are: a perceived lack of support for field trips from school administration, poor student attitudes and limited choices of local venues to suit their teaching objectives.<sup>14</sup>

## Virtual Field Trips

To quote Stevenson, “Virtual field trips are computer-generated environments that offer media-rich interactions with a particular location.”<sup>15</sup> Per Stainfield et al virtual field trips are “digital alternative representations of reality”<sup>16</sup> There are many types of virtual field trips ranging from

travel brochure replicas, groups of links that share a theme, faculty-produced interactive websites with software such as TourMaker<sup>®</sup>,<sup>17</sup> and professionally produced, interactive venue websites, videoconferencing and even field trips with an avatar. This paper is focused on the use of a professionally produced interactive venue that is part of the Queens Botanical Garden website, which can be toured via location or theme and matches the touch screen computers located throughout the Visitor and Administration Center that can be accessed during an actual tour.<sup>18</sup>

The benefits of virtual field trips are the solutions to many of the actual field trip problems. Virtual field trips have little to no additional cost if a site-produced link such as that used for this study is used, there are no transportation issues or distances to travel, they are more convenient for students and faculty with physical impairments, weather is not a factor, less time is necessary, they can be easily scheduled during a set class time and they allow access to places that may be impossible to visit as a class.<sup>19</sup> Other benefits of virtual field trips are that they can offer students self-directed research activities, they are easily repeated, computers can easily display different scales of an object under study, and unlike actual field trips, virtual field trips can be stopped at the end of one class and restarted at another time.

Problems associated with virtual field trips compared to actual field trips are that they are only abstractions of the real thing,<sup>20</sup> they lack three-dimensional views, they appeal only to the auditory and visual modes of learning, premade virtual material may not be available for a preferred location, premade virtual field trips do not allow the faculty to control the presentation, the language used may not be at the educational level of the participating students, and students may view working on a computer as a passive activity.<sup>21</sup> Also, unless videoconferencing or instant messaging is used, the virtual field trip may not offer an opportunity for student questions and feedback.

### Research on Actual Field Trips Compared to Virtual Field Trips

Although virtual field trips require less preparation for logistics and financial requirements, they need the same amount of planning as an actual field trip with regard to creating active participation and follow-up activities.<sup>22</sup> Faculty who are considering the adoption of an actual or virtual field trip into their courses are advised to take the chosen type of field trip without their students at least once prior to walking their class through the trip.

In a similar study, Spicer and Stratford conducted a test to investigate to what extent virtual field trips could replace actual field trips. They evaluated questionnaires from a group of biology students who took a virtual field trip and then completed a questionnaire. Ten months later, the same group of students took an actual field trip and again filled out a questionnaire. Their findings showed that the students enjoyed the virtual field trip's interactive technology and they felt it encouraged independent thinking. However, the students were adamant that virtual field trips "could not and should not replace real field trips." The conclusion of their study was that virtual field trips were most effectively used as a tool to prepare for an actual field trip or as a means to review an actual field trip after the participants' return.<sup>23</sup> In a separate study, Bellan and Scheurman shared this point of view. They found that virtual field trips cannot completely replicate the experience of being physically in a location. Like Spicer and Stratford, they too recommend using the online resources of a virtual tour to inform students about the proposed site

and to prepare questions about the location before their actual trip.<sup>24</sup> Two other studies by Whitelock and Jelfs and by Arrowsmith<sup>25</sup> et al concur with these points. Per the Whitelock research, “students believe that field excursions are a valuable learning resource; and most students disagree that VFTs (Virtual Field Trips) should replace fieldwork.”<sup>26</sup>

On the quantitative side, there are few published results available to date. Three examples found are listed here. Lewis found in his testing of 8<sup>th</sup> grade science students that there was no significant difference in learning scores between actual and virtual field trip participants.<sup>27</sup> Puhek et al found that there were only minute differences in the acquired knowledge between the participants of their actual and virtual field trip groups.<sup>28</sup> Hurst also reported that results from his test on college level geology students showed no significant performance difference between the actual and virtual field trip student participants.<sup>29</sup>

## Methodology

Field trips are not part of the normal curriculum for the freshman Materials and Methods of Construction I course at our institution. Faculty may add them to their courses at their discretion. The Materials and Methods of Construction I course is a 3-hour per week class and is a required course for all students in the Architecture and Construction Management Department. At the beginning of the Fall 2012 semester, 2 sections of a Materials and Methods of Construction I course, each with 25 students, were instructed that they would be going on a sustainable building field trip, one group on an actual field trip and the other on a virtual field trip, to the Visitor and Administration Center of the Queens Botanical Garden (QBG), Flushing Queens, NY, the following week. The actual field trip section of this course, the test group (n=25), was given a pre-test at the beginning of the field trip to assess their sustainable construction knowledge prior to taking the tour. They were also informed that they would be tested on their knowledge gained immediately after the tour. The tour was provided by a tour guide employed by the Queens Botanical Garden. Prior to the trip, the tour guide was informed that a second group would be taking a virtual field trip using the QBG website, and was asked to duplicate the information found there in the presentation to the actual field trip group. At the end of the tour, each student completed a post-test to assess the sustainable construction knowledge gained from the tour. It should be noted that the tour fee for this group was paid for by part of a Title III, Students First Grant, awarded to their professor to introduce sustainable construction to freshman students. The field trip was arranged during a regular class time and the tour lasted 1 1/2 hours.

A second section of Materials and Methods of Construction I class, the control group (n = 25) stayed on campus. They were given the same sustainable construction pre-test prior to taking an online tour on the QBG website titled “Click Your Way Through QBG’s LEED® Platinum Project” (<http://www.queensbotanical.org/media/file/QBG.swf>) during class time in a computer lab in the same building as their classroom. This group was also informed that they would be tested on what they had learned on their tour immediately following the tour. Each student conducted a virtual tour, which contained the same topics as covered on the real field trip. The students were given the same time as the real field trip participants (1 1/2 hours) to complete the virtual field trip, and immediately following completed the same post-test to assess their sustainable construction knowledge learned from the tour. There was no financial cost for the virtual field trip.

Both groups were advised prior to the qualitative pre and post-tests that the tests would be graded and would be part of their final grade for the course. After each tour ended, both groups completed a blind survey to assess their opinion of their tour.

### Results

The quantitative pre and post-tests for each group are as follows:

<b>ACTUAL FIELD TRIP</b>				<b>VIRTUAL FIELD TRIP</b>			
Student # Group A	Pre-Test Out of 8	Post-Test out of 8	Difference	Student # Group B	Pre-Test Out of 8	Post-Test out of 8	Difference
1	3	8	5	1	3	3	0
2	2	7	5	2	1	6	5
3	3	8	5	3	0	5	5
4	1	8	7	4	1	5	4
5	3	8	5	5	2	6	4
6	1	8	7	6	3	5	2
7	3	8	5	7	1	2	1
8	1	7	6	8	1	8	7
9	2	8	6	9	4	8	4
10	1	8	7	10	3	4	1
11	3	8	5	11	5	8	3
12	2	8	6	12	5	8	3
13	1	8	7	13	4	8	4
14	0	8	8	14	2	3	1
15	0	8	8	15	2	6	4
16	0	8	8	16	0	2	2
17	5	8	3	17	0	5	5
18	1	8	7	18	1	8	7
19	0	6	6	19	1	6	5
20	2	8	6	20	1	6	5
21	0	8	8	21	0	7	7
22	1	8	7	22	0	6	6
23	2	8	6	23	1	8	7
24	1	8	7	24	2	7	5
25	0	8	8	25	0	4	4
<b>AVERAGE</b>	<b>1.52</b>	<b>7.84</b>	<b>6.32</b>	<b>AVERAGE</b>	<b>1.72</b>	<b>5.76</b>	<b>4.04</b>

### ACTUAL FIELD TRIP VS VIRTUAL FIELD TRIP VIRTUAL RESULTS

t-Test: Two-Sample Assuming Equal Variances

	<i>Actual</i>	<i>Virtual</i>
Mean	<b>6.32</b>	<b>4.04</b>
Variance	1.64	4.12
Observations	25	25
Pooled Variance	2.88	
Hypothesized Mean Difference	0	
df	48	
<b>t Stat</b>	<b>4.75</b>	
P(T<=t) one-tail	0.0000095	
<b>t Critical one-tail</b>	<b>1.68</b>	
P(T<=t) two-tail	0.0000190	
<b>t Critical two-tail</b>	<b>2.01</b>	

The qualitative survey results are as follows:

Note:

Likert Scale Used: Strongly agree = 4, Agree = 3, Disagree = 2, Strongly Disagree = 1  
 Actual = Actual field trip      Virtual = Virtual Field Trip

- Please indicate the type of field trip that you have completed:  
 Actual (real) field trip = 25 students      Virtual (online) field trip = 25 students
- This field trip increased my interest in learning more about sustainable construction methods:  
 Actual = 52% Strongly Agree      Virtual = 36% Strongly Agree  
 40% Agree      40% Agree  
 8 % Disagree      24% Disagree  
 Actual = 3.44 Average      Virtual = 3.12 Average
- I learned more information on sustainable construction than I knew before this trip:  
 Actual = 72% Strongly Agree      Virtual = 44% Strongly Agree  
 28% Agree      56% Agree  
 Actual = 3.72 Average      Virtual = 3.44 Average
- Based on my field trip experience, I see that sustainable construction is achievable:  
 Actual = 76% Strongly Agree      Virtual = 60% Strongly Agree  
 24% Agree      32% Agree  
 8% Disagree  
 Actual = 3.76 Average      Virtual = 3.52 Average
- Having the field trip during class time made it easier for me to attend:  
 Actual = 68% Strongly Agree      Virtual = 60% Strongly Agree

32% Agree  
Actual = 3.68 Average

40% Agree  
Virtual = 3.6 Average

6. This field trip is appropriate to the level of the Materials and Methods of Construction I course I am currently taking:

Actual = 52% Strongly Agree  
48% Agree

Virtual = 36% Strongly Agree  
60% Agree  
4% Disagree

Actual = 3.52 Average

Virtual = 3.32 Average

7. I would take an Architecture/Construction Management program course with this type of field trip instead of an Architecture/Construction Management program course with no field trip:

Actual = 36% Strongly Agree  
60% Agree  
4% Disagree

Virtual = 48% Strongly Agree  
36% Agree  
16% Disagree

Actual = 3.32 Average

Virtual = 3.32 Average

Only for [Actual] Field Trip Group:

8. I preferred to arrange my own transportation to the field trip than to share in the cost for a group bus from campus: (online tour students please leave this blank)

Actual = 32% Strongly Agree  
32% Agree  
16% Disagree

Actual = 2.76 Average

9. I would have preferred to take this field trip online instead of visiting the site in person: (online tour students please leave this blank)

Actual = 76% Disagree  
24% Strongly Disagree

Actual = 1.56 Average

Only for [Virtual] Field Trip Group:

10. I would prefer to take an actual field trip instead of a virtual field trip: (Actual field trip students please leave this blank)

Virtual = 36% Strongly Agree  
36% Agree  
24% Disagree  
4% Strongly Disagree

Virtual = 3.04 Average



## Conclusion

The metrics used in this analysis were pre- and post-tests on the topic of sustainable construction, and a post-activity student survey. The quantitative results seen in this small study were statistically significant, showing that the actual field trip was more effective as a learning tool than the virtual field trip.

The results of the perceptual survey show the following:

1. Compared to the virtual field group of students, 28% more of the actual field trip participants “strongly agreed” that they learned more about sustainable construction on their field trip.
2. All of the actual field trip participants preferred to attend an actual field trip than a virtual field trip as opposed to 72% (strongly agreed/agreed) of the virtual field trip participants who would have preferred to have taken an actual field trip.
3. The majority of each group agreed that they prefer courses that have an actual/virtual field trip to courses that do not incorporate a field trip at all.
4. Compared to virtual field trip participants, 16% more actual field trip participants strongly agreed/agreed that their field trip increased their interest in learning more about sustainable construction methods.

Although the results show that students strongly prefer an actual field trip over a virtual one, the data also suggests that virtual field trips should be considered a dynamic, useful learning tool. In addition, use of mixed methodologies, such as addition of a forum to learn some of the reasons for the student answers to the survey, would add valuable information.

The conclusion of this study is that actual field trips were significantly more effective in improving student learning outcomes and student perceptions than virtual field trips. More research is warranted, however, with a larger sample size. A literature review confirms that this is an area that would benefit from more research. Future studies are also needed to examine the benefits of a virtual field trip, including cost, convenience, accessibility and timing during class hours. Further investigation of the differences between the two methods may lead to new knowledge of what could be changed in either one to enhance student learning outcomes.

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<sup>4</sup> Ignatiuk, G., *Influence of the Amount of Time Spent in Field Trip Activities on Student Attitude Toward Science and the Environment*. S.S.T.A. Research Centre Report No. 49, Canada-Saskatchewan, 1-9.

<sup>5</sup> ABET – *Assuring Quality in Technical Education*, [www.abet.org](http://www.abet.org)

<sup>6</sup> Krepel, W., & DuVall, C., *Field Trips: A Guide for Planning and Conduction Educational Experiences*, Analysis

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