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Flip, Move, Tweet: A Blended Course Design for Different Learning Environments in Urban Planning, Sustainability, and Climate Change University Courses

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Abstract
While much academic work has focused on how a singular teaching practice impacts student engagement and learning, synergies among innovative teaching practices have largely been ignored by the academic community. I seek to address this gap by proposing a new blended course design and report on the impact three innovative teaching practices (flipped class, movement, and twitter) combined had on ten undergraduate students taking an urban planning course focused on sustainability and climate resilience. I explore advantages and disadvantages of this course design through pre- and post-diagnostics, audio and video recordings, tweets, assignments, student feedback, and personal reflection. Because students adapt to their learning environments and showed learning gains especially in environments they had not been taught in before, I suggest that students need to learn in the places they ultimately work.

Keywords: blended course design; twitter; movement; active learning; experiential learning, small classes

Introduction

My goal is to introduce an exploratory blended course design that combines three innovative teaching practices. The first teaching practice is a flipped classroom, in which traditional, lecture-style course content is provided to students online prior to each class, to save class-time for discussions (Fulton, 2012). The second teaching practice is a moving classroom, which is based on the knowledge from neuroscience that humans retain more knowledge when they move – walk, exercise etc. (Doyle and Zakrajsek, 2011). The third teaching practice is a tweeting classroom, during which students communicate via twitter to facilitate the moving classroom. Students learn better when they can frequently engage with the instructor and their peers throughout class (McKinney and Heyl, 2008).

While much academic work has focused on a single teaching practice and its impact on student engagement and learning, the synergies among these innovative teaching practices may yield new insights into advancement of teaching and learning. Therefore, I developed a blended course design called the "flipping, moving, and tweeting classroom" and suggest tentative findings about possible engagement and learning gains as a starting point for research ideas to explore these scholarship of teaching and learning topics. I implemented the flipping, moving, and tweeting classroom in a bi-weekly urban planning college course on sustainability and climate resilience. During the first class of every week, content on sustainability was taught "innovatively:" flipped, moving, and tweeting. In

contrast, the second class of every week, content on climate resilience was taught "traditionally:" lecture (non-flipped), in-class (non-moving) and face to face (non-tweeting). While this course design is meant for small class sizes, my question guiding the inquiry of possible learning gains was: Can a combination of innovative teaching practices enhance my students' engagement and learning?

In order to answer this question, I assessed student engagement and learning through pre- and post-diagnostics, audio and video recordings, tweets, assignments, student feedback, and personal reflection by comparing the differences between the traditional classroom and the innovative classroom. To foreshadow my recommendations based on this report, students adapt to their learning environments and show learning gains especially in environments they have not been taught in before. I pursue two goals with this report. First, I introduce a new blended-course design that could be applied to urban planning, sustainability, and climate change courses. Second, I explore possible engagement and learning gains, implementation barriers, and student perceptions through this blended course design.

Literature review

Blended course designs

Blended course designs utilize a multi-modal teaching and learning approach, which may include lectures, online modules, active learning, service learning, etc.., to offer students a variety of paths to master the subject and stimulate their motivation to learn (Kolb et al., 2001). Blended course designs play to different learning preferences of students by teaching in their preferred learning situation (Anderson and Adams, 1992). As a result, blended course designs have shown to significantly improve student performance and to increase graduation rates (Kamruzzaman, 2014; Kolb et al., 2001). With growing globalization and widening socio-economic divides, educators face an increasingly diverse set of learners for which blended course designs may offer ways to provide all students with an authentic and personalized educational experience. This holds especially true, if courses incorporate active and experiential learning exercises (Ambrose et al., 2010).

The evolving stream of literature on blended courses and in particular the three elements of this course design supports the general notion that flipped classrooms, movement, and social media can support student engagement and learning (Doyle and Zakrajsek, 2011; Fulton, 2012; McKinney and Heyl, 2008). However, each teaching practice bears significant learning challenges and poses risk of multiple learning losses, such as distractions by social media, new environments, and adaptation barriers for instructors. Despite these challenges, Hicks and Graber (2010) encourage educators to find ways to use new media technologies in their classrooms. This report takes this assertion to extend the learning experiences beyond the classroom and uses the natural and built environment to teach awareness about sustainability as well as the knowledge, skills, and dispositions necessary to articulate and act upon our need to incorporate sustainability into our cities, communities, and individual lives. In the following literature review, I briefly introduce each teaching practice as well as possible gains and risks for student engagement and learning.

The conveyance of basic knowledge: Flipped classrooms as a teaching practice

In the traditional classroom setting, the educator presents material to the students, who post-class process the presented material independently through assignments at home. In contrast in the flipped classroom, students are presented with basic knowledge through short video lectures, online assignments, and readings prior to class, and engage in interactive activities with each other and the instructors during class (ELI Publications, 2012). Sometimes, instructors quiz the class the night

before the lecture, to tailor that lecture to the classes' progress (Bergmann and Sams, 2012). Because students have gained a basic understanding of a concept prior to class, the follow-up discussion-based classrooms allow them to engage with the material on a higher cognitive level (Bergmann and Sams, 2012; Bishop and Verleger, 2013). "Flipped" classrooms basically address students' misconception of, or struggles with materials in class, as a team and with the instructor and consequently students perform better on exams (Berrett, 2012).

While many have praised the flipped classroom as a success, it has several challenges in implementation. First, if instructors record video lecture, it requires them to invest much time prior to class (Bishop and Verleger, 2013). Consequently, veteran educators may have to develop a whole new skill set if they were to teach in flipped classrooms (ELI Publications, 2012). Second, the role of technology in teaching has been disputed. Bishop and Verleger, (2013) have asserted that many more studies are needed to test the effect of technology on the learning process. Even though few studies have assessed student performance in a flipped classroom, those who did found improvement in student performance (Day and Foley, 2006; Moravec et al., 2010).Third, approval by students of flipped classrooms are mixed despite the positive results on exams and progress (Berrett, 2012).

The role of neuroscience and the brain in learning: Moving as a teaching practice

The neuroscience community has largely agreed that movement and cognitive skills are strongly connected. First, the cerebellum, the part of the brain that is most associated with motor control, also processes new information to form permanent memories, or learning (Ivry and Fiez, 2000; Jensen, 2005a). Second, studies have found that there are strong links between the cognitive and movement centers of our brains. For example, functional magnetic resonance imaging has shown that our movements are preceded by rapid thoughts to determine the goals of our movement and possible influencing variables (Flanagan et al., 2003). Third, oxygen is essential for brain function. Because exercise increases blood flow, more oxygen is circulated in the body, thereby increasing brain function (Jensen, 2005a). Fourth, memory is enhanced through short exercise breaks, allowing the hippocampus (the memory center of the brain) to process the newly absorbed information (Jensen, 2000).

This anatomy background alone supports the notion that movement and learning are strongly connected. Academic scholars have found supporting evidence of how movement can positively impact learning (Medina, 2008). For example, Shoval (2011) found that subjects were much more likely to retain information if they had kinesthetic, tactile, visual, or verbal interaction in their learning environment. Experiential learning is linked to better student performance (Kolb et al., 2001). Because hormones that make us feel happy are released through movement, exercise relieves stress (Lengel and Kuczala, 2010), leads to more positive social interactions (Boswell and Mentzer, 1995), and aids adolescents through hormone imbalances (Jensen, 2000). Consequently, less stress, positive attitudes, and calmness are linked to better student performance. Further evidence for learning through movement comes from Hillman et al. (2009) who found that preadolescents performed much better on reading comprehension after having completed exercise routines as opposed to those who rested. Likewise, school children performed better if they were physically fit and active (Helgeson, 2011). Finally, kinesthetic learners commonly struggle with the traditional teaching system (Honigfeld and Dunn, 2009; Wells, 2013). Adding movement to the curriculum and into everyday classroom activities would give these types of learners a greater opportunity to be en par with their audio-visual oriented peers. Moving while learning, however, does pose its challenges as it requires the learner to

multitask. Learners performing more than one task experience cognitive distractions, thereby performing less efficiently (Ophir et al., 2009). In the context of this blended-course design distracted walking, and tweeting while walking might prompt my students to lose focus.

Twitter as a communication mechanism: Tweeting as a teaching practice

Twitter as a social media tool allows students to digitally interact, communicate, and collaborate among themselves or with the instructor, inside or outside the classroom, simultaneously or across space and time. Tweets, brief messages that are posted on the world wide web made of 140 characters or less, can contain pictures, text, videos, and links. By 2014, twitter has become the most used micro-blogging tool across web 2.0 applications. For educational purposes, tweets can provide a level of discourse in a virtual space through expressing ideas, creating or critiquing concepts, providing instant feedback to the instructor, or connect peers to share their ideas (Sweeney, 2012). Twitter is a powerful tool in applying and creating ideas (Kassens-Noor, 2012) and extremely useful during field trips (Richardson, 2009).

Twitter can have a positive impact on student engagement and learning (DeCosta et al., 2010; Dunlap and Lowenthal, 2009; Junco et al., 2010; Kassens-Noor, 2012). In particular this online communication tool fosters mutual learning (Stephansen and Couldry, 2014), active learning (Aspden and Thorpe, 2009), collaborative learning (Corbeil and Corbeil, 2011; Rheingold, 2010) and can aid to model techniques and skills students can use in real life (Holmes et al., 2014). Kassens-Noor (2012, p. 19) advises that "if instructors intend to engage students on a particular subject matter, bridging theory and practice while including real world examples (linear applicative learning), twitter provides distinct advantages over the traditional individual homework assignments and in-class discussions." These advantages include the opportunity to teach across space and time, apply theoretical concept to observations, and provide hands-on experiences. Because twitter also has the distinct advantage to bridge space (Cochrane, 2010; Saeed and Sinnappan, 2011), it bodes well for a course that is moving and taught outside.

While the educational community has rarely addressed and measured the risks to learning when using social media, the organizational literature has expanded significantly on the risks web 2.0 can pose (Shabgahi et al., 2013; Wankel, 2009). One of the greatest challenges of working with social media is the many distractions an internet-enabled device can offer to students. Besides using twitter, they can surf the web, text or call their friends, play games and so forth.

Introducing a new Blended Course Design

My project goal is to combine three innovative teaching practices and track my students' engagement and learning between the innovative and traditional classroom settings. The innovative classroom includes flipped course content, movement, and twitter, while the traditional classroom was taught as a lecture (non-flipped), in-class (non-moving), and face to face (non-tweeting). The following methodology for the report is laid out in three sections: study participants, design and implementation procedure, and measures and analysis.

Participants

I taught the "flipping, moving, and tweeting classroom" design in a Midwestern Research Tier I University course, in which ten undergraduate urban planning students explored how to create sustainable and climate-resilient cities. This class lends itself to this course design, because the class

covered two major topics: sustainability and climate resilience. While climate resilience was taught traditionally, sustainability was taught through the combination of three innovative teaching practices as follows. First, the core concepts of sustainability, which I used to deliver in lectures during the first 20 minutes of each class, were flipped and offered to students online prior to class along with small assignments. This freed up valuable class time for the "moving" classroom to enable students to walk around campus, in order to identify and apply concepts taught in the flipped classroom session. Third, the "tweeting" classroom resolved the challenges of communication of the moving classroom.

Prior to the start of the study, the research was deemed as exempt by my university's institutional review board (IRB). The IRB is an appointed committee acting independently and ethically to protect the rights and welfare of human research subjects. All ten students taking this class provided informed consent to release their course data for use in this study. Following IRB protocol (x13-331e), tweets were recorded on a private twitter group site and classroom conversations were video and audio-recorded.

Design and procedure

In order to track the difference in my students' engagement and learning in the flipped, moving, and tweeting classroom, the project's methodology was based on a within-group, quasi-experimental design. While concepts of sustainability topics were taught via the triple innovative teaching practices, concepts of climate resilience were taught as an in-class, sitting, and face-to-face discussion course in order to create a control accounting for the difference in student engagement and learning. Figure 1 clarifies the content.

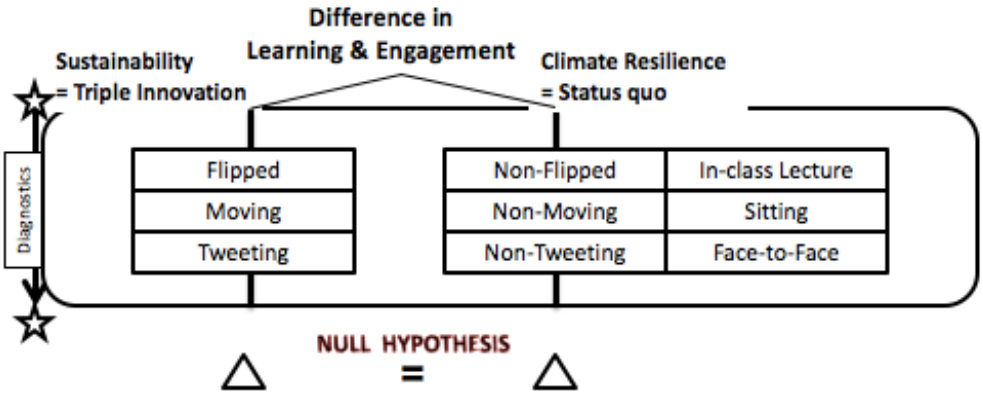

Figure 1 Blended Course Design for the flipping, moving and tweeting classroom

Source: the author

A sample course design for an outside classroom looked like this: I taught one class in and around a coffee shop. A week prior to class, I instructed my students to behave as sustainably as they possibly can and prepare accordingly. After completing the online lectures and assignments on sustainability, we spread across the coffee shop. I instructed my students to buy the most sustainable item they could. With this question, I stimulated multiple integrative solutions: the application of their readings and lectures, the critical comparison between energy consumption (does the item need to be heated?), transportation (where was the item produced?), labor (who worked to produce it?), packaging, and so forth. Each student then had to tweet what they bought and defend their choice against opposing

views from their peers and myself. I also asked them to move around the coffee shop, observe sustainable and unsustainable behaviors and ultimately engage one of the customers in a conversation about sustainability and their attitudes about it. After the conversation, they shared what they had learned via twitter.

A sample course design for the inside classroom looked like this: Students read material prior to attending class, then I would lecture about the readings' content and deepen the students' knowledge through in-class exercises. For example, after a brief lecture on renewable energy and energy savings to reduce carbon emissions, students responded to probing questions challenging the underlying assumptions of energy savings for climate resilience, e.g. the use of batteries in hybrid cars. Thereafter they worked in teams to redesign an existing neighborhood into an energy-savings neighborhood. They had to choose where to locate windmills, solar panels and which transportation means to use.

Six data sources were collected during the course: four diagnostics (see appendix), assignments, my self-reflective diary, tweets, audio and video-recordings and controls including participation (online and in-class), GPA, and weather condition. I designed the diagnostics as online surveys on google docs, which were validated and verified by three instructors, knowledgeable in climate-resilience, sustainability, and the scholarship of teaching and learning. Thereafter, all diagnostics were pilot-tested with students who had taken the course during the previous semester.

Measures and analysis

To explore the impact of the course on my students' engagement and learning, I implemented four diagnostics (see appendix), two of which assessed engagement and learning inside and two outside the classroom. Each diagnostic assessed both content areas: sustainability and climate resilience. The inside diagnostics were available for students to fill out in class (online or on paper) and with me present. Students had to answer multiple-choice and open-ended questions testing their knowledge and skills on sustainability and climate resilience. For the outside diagnostic, I took the students to a neighborhood none of them had ever been to, in order to let them assess the neighborhood as a whole, as well as particular features in regards to climate resilience and sustainability. Diagnostics could not be associated with any one student until the end of the course to eliminate any potential teacher-student power relationship bias. In the first week of class, the first set of diagnostics (one inside and one outside), testing knowledge, skills and dispositions about sustainability and climate resilience, were implemented. The diagnostics contained open-ended and multiple choice questions. To ensure comparability, the number of correct answers and distractors were the same in the sustainability and the climate resilience topics.

The second set of diagnostics (one inside and one outside) was run after the final exam in December 2013. Student learning outcomes were assessed using planning knowledge (e.g., to what extent can students recall sustainability and climate resilience concepts), skills (e.g., to what extent are students able to identify unsustainable planning practices in a new environment), and dispositions (e.g., to what extent have students changed their lifestyles towards more sustainable practices). While both sets of diagnostics contained the same questions, the post-course diagnostic had additional questions asking students to report about their own engagement, learning, and liking of the traditional and innovative class.

The diagnostics built the foundation for the analysis, identifying engagement and learning differences pre and post-class quantitatively (see results). The other data sources were qualitatively content-analyzed to explain such differences (see discussion). While the diagnostics were scored, tweets, audio and video-recordings were coded double-blind after conclusion of the course. I designed the score and code books and asked two research assistants, who did not know each other, to score and code the data sources independently. Once completed, I met with both students at the same time to discuss and remedy scoring and coding differences.

Reporting results of the Blended Course Design

This section reports on interesting findings of the study. I descriptively explore advantages and disadvantages of this course design through pre- and post-diagnostics, audio and video recordings, tweets, assignments, student feedback, and personal reflection.

Table 1 Overview of students' data, controls and overall knowledge and skill gains

Stud	*Attendance % of total (outside)*	*Attendance % of total (inside)*	*G P A*	*Prior Class*	*Inside Diagnostic (pre)**	*Inside Diagnostic (post)**	*Learn Gains*	*# of Tweets*	*Outside Diagnostic (pre)**	*Outside Diagnostic (post)**	*Learn Gains*
A	86%	100%	2.9	0	67%	72%	5%	101	33%	63%	30%
B	100%	100%	3.7	2	66%	75%	9%	69	70%	80%	10%
C	71%	93%	3.5	0	70%	75%	5%	63	40%	80%	40%
D	71%	86%	3.3	0	76%	80%	4%	63	73%	80%	7%
E	100%	100%	3.9	1	74%	71%	-3%	64	73%	87%	14%
F	100%	100%	3.9	1	74%	75%	1%	99	60%	80%	20%
G	64%	71%	2.7	1	56%	58%	2%	21	47%	53%	6%
H	93%	100%	3.5	1	64%	69%	5%	56	37%	40%	3%
I	64%	79%	2.3	2	72%	70%	-2%	51	53%	67%	14%
J	93%	93%	3.7	3	72%	77%	5%	60	83%	83%	0%
Ave	**84%**	**92%**	**3.3**	**1.1**	**69%**	**72%**	**3%**	**65**	**57%**	**71%**	**14%**
Instr.	100%	100%						203			

Source: the author
Notes: * indicated the percentage of correct answers

The class of 10 undergraduate students had an average GPA of 3.34. Prior knowledge on the topics of sustainability was more evident, assessed by the courses they had previously taken on the topic. The weather played a certain role in non-participation in the outside classroom excluding two scheduled long-distance field trips, during which students remained primarily inside. Given this course was taught in fall 2013, the weather changed significantly from being sunny with 75F (late August) to snowing, raining with 40F (early December). A further observation was that those students who had the least knowledge on either topic gained comparatively more knowledge than their peers who had taken prior classes on sustainability or climate change.

Finding #1

In the outside learning diagnostic (Figure 2), my students showed learning improvements on both sustainability and climate resilience. Overall learning gains averaged 14.3% in the outside diagnostic compared to 3.5% in the inside diagnostic.

Finding #2

My students had bigger learning gains on climate resilience inside (this topic was taught inside the classroom) and bigger ones on sustainability outside the classroom (this topic was taught outside the classroom). Students improved on average 16% between the pre- and post-diagnostic on sustainability questions outside and 13% on climate resilience questions outside. In the inside diagnostic, students averaged 2% on sustainability and 5% on climate resilience.

Finding #1 and #2 combined might suggest that my students show more learning gains in the environments they are taught in, while they are able – yet to a lesser extent - apply concepts taught in a different learning environment to a new one.

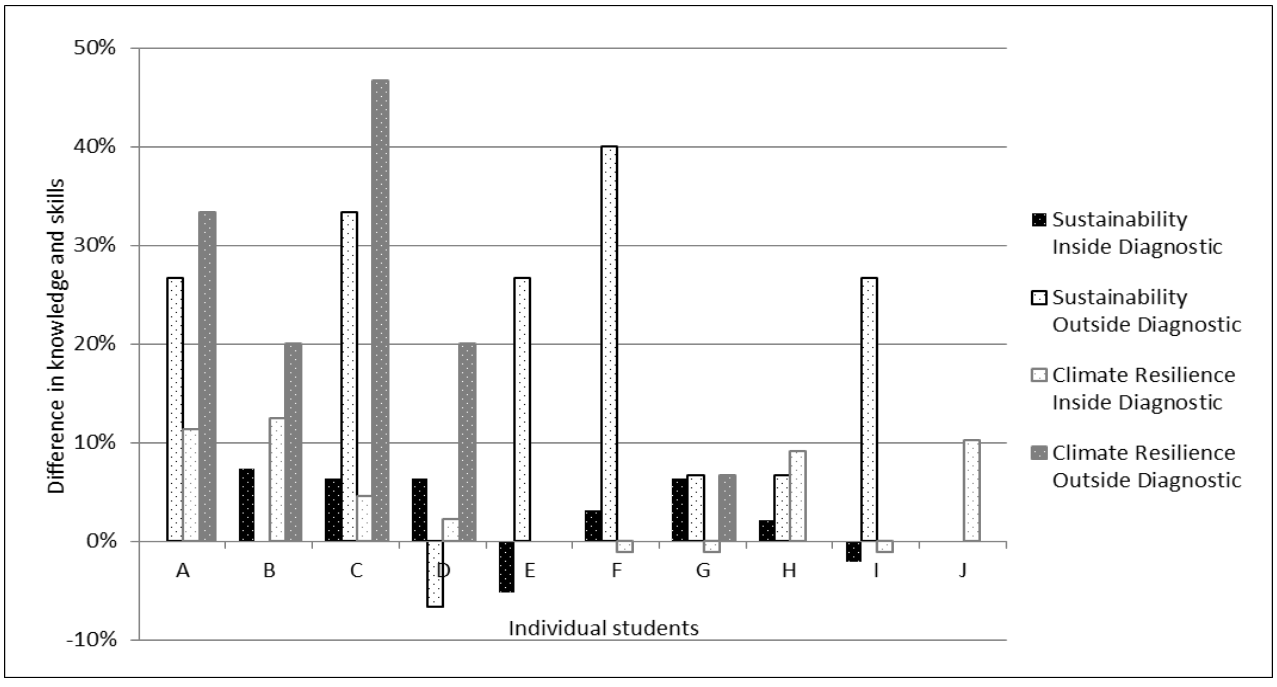

Figure 2 % Differences in knowledge and skill gains between sustainability (inside and outside) and climate resilience (inside and outside)

Source: the author
Notes: Difference in knowledge and skills indicates % difference of correct answers (+ increase, - decrease)

Finding #3
Students perceived to be more engaged and to have learned more in the traditional classroom setting (lecture, sitting, face to face discussions).

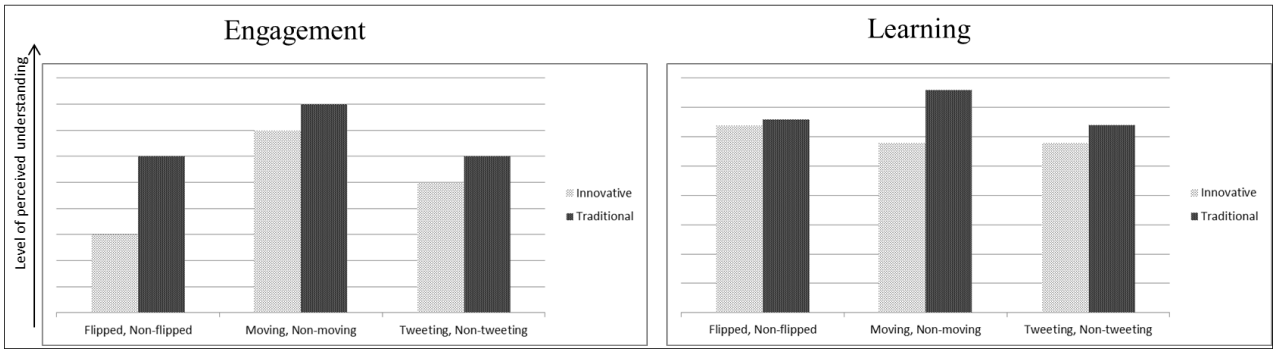

Figure 2 Student perceptions of engagement and learning

Source: the author
Notes: Graphs report on students ranking of themselves how well they understood the material ranging from (0=not at all and 5=complete understand) in the traditional and in the innovative class setting

Finding #4
My students' dispositions of intentions and behaviors changed. Over the course of the semester, my students adopted lifestyles and beliefs that were more sustainable and climate resilient than before taking this course. Across the three dispositions, intentions changed the most, then did behavior. However, the diagnostics showed almost no change in attitudes.

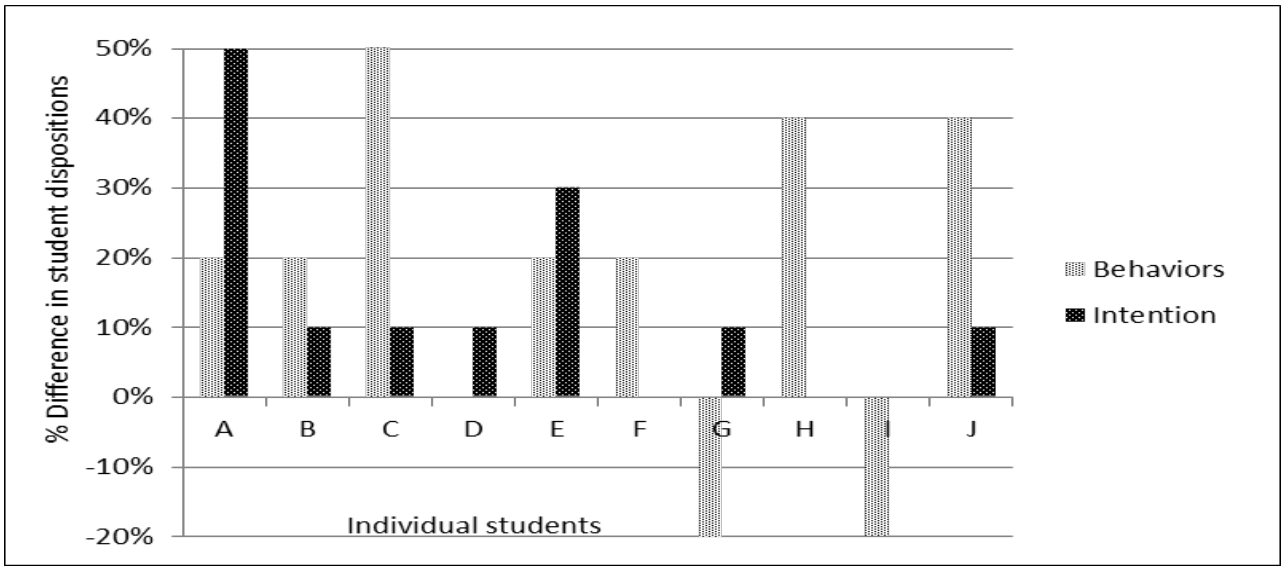

Figure 3 % Differences in Student Dispositions (intentions and behaviors)

Source: the author
Notes: Differences in student dispositions indicates % difference of positive answers (+ increase, - decrease). Behaviors and intentions were assessed on climate resilience and sustainability questions combined, e.g. do you recycle, do you switch off lights when you leave the room.

Discussion

This study reports on an innovative course design for an urban planning and sustainability course in a Midwestern Tier I research university and reports on four findings through the diagnostics on the ways in which a combination of multiple teaching practices enhanced student engagement and learning. This can be a starting point for research ideas to explore these scholarship of teaching and learning topics. This discussion section interprets the findings by adding qualitative information from the other five data sources (audio and video recordings, tweets, assignments, student feedback, and personal reflection), connects the results to the concurrent literature, and highlights potential benefits and pitfalls of the flipping, moving and tweeting classroom.

Finding #1

One explanation of the learning gains in the flipping, moving and tweeting classroom is that my students had never been taught outside before and hence one can observe the early stages of a rapid learning curve (Yelle, 1979). This finding would also support knowledge from neuroscience on the positive connections between movement and learning (Kolb et al., 2001; Medina, 2008; Shoval, 2011). Even though the diagnostic results can only be seen as exploratory given the small number of students, the results indicate the potential innovative teaching practices may have in today's classrooms. Furthermore, working with new technologies and in work-related environments is an expectation millennial learners set on college classrooms (Kvavik and Caruso, 2005; Roberts 2005). Ultimately, millennials will take charge of their own learning through web 2.0 access (Rheingold and Weeks, 2012). If skeptics still point to the fact that the outside learning environments offer too many distractions for learners, may I suggest watching the youtube video that went viral several years ago and has been updated yearly titled "Did You Know? Shift Happens / Higher Education". In this video, it becomes evidently clear that students today face significantly different challenges and work environments, in which distractions have become a common denominator. Only if we teach them on how to focus on the most important given the many distractions, can we efficiently prepare them for the work place.

Finding #2

There may be several reasons on why my students learned more on climate resilience inside and more on sustainability outside the classroom. First, student adapt to their learning environments (Jensen, 2005b). Because I taught my students how to assess, apply, and preserve sustainability in the outside classroom, it was easier for them to apply such knowledge in that particular environment. Vice versa, because my students were educated on climate resilience inside the classroom, the diagnostic tests in the classroom came easier to my students. This might implies that teaching in authentic ways produces more relevant learning gains. Consequently, I suggest to educate students in their professional and in their personal environments to prepare them for their post-graduate work lives and to encourage change towards more sustainable lifestyles respectively. Second, previous knowledge on sustainability was much greater than on climate resilience and consequently the learning curve might not have been as steep and yielded only marginal learning gains on sustainability (Yelle, 1979). One student wrote in his/her self-reflection: "seeing concepts illustrated first-hand makes me remember them very well."

Finding #3

Contrary to my students' perceptions of their own learning gains (they perceived to have learned more in the traditional classroom setting vs. the flipping, moving and tweeting classroom), findings #1 and #2 indicate the opposite. One explanation of the different perceptions of students might be that the triple-innovation teaching environment poses challenges to the learner (e.g. attention) that has been trained to learn in an in-class room non-distracting setting. For example, one student wrote in his/her self-reflection about the course "walking around makes tweeting, listening to different people and learning all simultaneously very hard." College students are used to the traditional learning environment of in-class, lecture-style, and face-to-face discussions, whereby the distractions were new to my students learning experience and consequently they had to adapt their learning and understand how to multitask and cope with these distractions. This finding is similar to that of Prestidge's (2014), who found that students struggled with the functionality and conceptualization of Twitter as a new learning tool. Evidence of collaborative learning on twitter did exist. For example, my students favored some of my tweets prior to the in-class exams. While this collaborative approach to learning supports Stephansen and Couldry's (2014) observation that the technologies enabled mutual learning, it does stay in contrast to finding, that students "missed [the] opportunity to be collaborative active learners" on twitter (Prestridge, 2014, p. 704). Another possible explanation is students' limited perspective on what "learning" is. Students might think of "learning" as the kinds of things that happen in a classroom, and are measured with pencil and paper tests.

Finding #4

The change in my students' dispositions, as indicated by the diagnostic, suggests that this blended course design might be a way to stimulate social change in students towards a more sustainable lifestyle (Pratt, 2002). The triple innovation brought hands-on and applicable sustainability experience to my students. This type of experiential learning can support student engagement and learning (Ambrose et al., 2010; Kolb et al., 2001). According to my student's perceptions, the class taught at the coffee shop left a strong impression on how student's daily choices can affect sustainability. The twitter extract (Figure 4) illustrates the collaborative nature on twitter, the experiential learning environment, and the interactions between me and my students.

Figure 4 Tweeting sample

Note: SCRCities 2013 is me (the instructor)

Obviously, there are many differences, positive and negative, between the traditional class-room and the courses taught with the triple innovation. The overall impression of my students was that the traditional classroom offered more structure, more organization, and fuller discussion, while the outside classroom was perceived as more interactive, hands-on, fun, and challenging. The audio and video-recordings clearly showed the directed discussions between myself and my students, while twitter removed such communication barriers and students more freely responded to each other. In particular, the quiet students interacted more frequently on twitter than in the in-class discussions. Based on my experience, the design of the course in itself required more time commitment than expected: the online lectures needed to be recorded, online assignments developed, time needed to be set aside after each class to go through the tweets in order to respond to unanswered questions and correct misconceptions. Likewise, my students invested more time, because they needed to familiarize themselves with the new technology and prepare their course material thoroughly before class, e.g. we set two classes aside just to install and test twitter. These experiences resonated with previous findings, where learners and teachers needed to commit significant time and take considerable efforts on the use of smart tools (Ha and Kim, 2014). Another challenge my students and I faced was our demand on twitter to act as a just-in-time communication tool, meaning, we expected to see the tweets from others immediately upon posting them. Due to weaker 3G coverage and server updates, the tweets were occasionally delayed (up to 2 minutes).

Limitations of the study

The study artificially splits concepts of sustainability and climate resilience. I did so to create a quasi-experimental design and thereby a control for engagement and learning gains between the classes taught with the triple teaching innovations and the traditional method. If instead of different topics

different sections were used, the bias of teaching different learners in differing environments would have arisen. To keep the teaching environment between both topics constant, the same amount of time was devoted to both concepts over the course of the semester. In addition, I measured exposure to the material, by accounting for attendance and participation during class. The separation between sustainability and climate resilience was also possible, because the difficulty in understanding both concepts is comparable. Furthermore, the guest lectures for a specific topic, e.g. housing, remained the same, while I prepared the guests to teach with both methodologies and was present during all classes.

The course had only ten students. Therefore, the data cannot be evaluated through statistical methods and my findings can only be seen as a starting point for research ideas to explore these scholarship of teaching and learning topics. To obtain more reliable results, this study theoretically would need to be repeated with more participants to draw statistically significant conclusions. However, applying this course design to larger groups of students poses significant challenges for the instructor and might be impossible. For example, responding to tweets of only 10 students during class was impossible. Hence, the course design as is is meant for small, specialized class sizes. Despite its challenges, the study does provide an indication of possibilities this blended course design might have on student engagement and learning. This should encourage others to think outside the traditional classroom setting and take students to places in which they have to apply their knowledge and skills.

Conclusions, recommendations and teaching tips

The goal of this report was to introduce an innovative blended course design for urban planning, sustainability and climate change courses that addresses multiple learning preferences, such as kinesthetic, audio-visual, and so forth. The scholarship of teaching and learning has repeatedly emphasized that concepts taught through a multi-modal teaching approach establishes better and stronger connections within the brain, and ultimately enhances long-term memory. This exploratory study has shown that my students showed learning gains, especially in environments they are traditionally not exposed to, yet need to perform in once they enter a work place post-graduation. It is worth considering whether this course design can be applied to topics and contents taught across urban planning courses, especially as the planning discipline is practitioner-oriented that needs our students to be engaged in their environments to stimulate social change.

Even though the study was only exploratory, there are some valuable recommendations and tips I would like to share with those thinking about applying this course design to their own course:

1. Assign individual tasks to tweeters. For example, in a transportation planning class, one student could observe drivers, the second cyclists, the third pedestrians etc. Because when each tweeter has a task, they have a responsibility to share it with the class and multiple viewpoints can be integrated on twitter.
2. Spread-out students within a confined area. Through twitter, observations can cover larger areas and results can be shared online.
3. Go undercover. When students feel their perspective is unique and they are able to discuss unsustainable behavior freely (through the private twitter site), it empowered them to explore concepts on their own, share them, and defend their arguments.

Other tips include sending an email the day before class clearly stating the learning goals, expected learning outcomes and instructional objectives for the upcoming class and outlining the tasks for that particular session.

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