

# A Geodesign Exercise: First Experiences

By

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## Abstract

This paper describes a geodesign project assigned as an extra credit assignment within a traditional GIS course. Research suggests that today's neomillennial learner is particularly receptive to this type of educational experience. The exercise is based on a study of the Valles Caldera National Monument of Northern New Mexico. There is pending congressional legislation that, if passed, would transfer management of the caldera from the Valles Caldera Trust to the National Park Service. A primary focus of the exercise is to engage the millennial learner by immersing him or her in a real-world scenario with real outcomes. Initial experiences begin by assigning discussion questions that are designed to provide them with an initial familiarity with the physical and environmental setting of the preserve, its significance as a preserve, and the spatial components that allow them to employ GIS to evaluate it. Additional discussion questions require them to read and respond to existing management documents and strategic plans, to evaluate the existing Valles Caldera geodatabase, and to ascertain the degree to which the GIS as it exists satisfies the existing strategic plans. Embedded in this exercise is a GIS analysis requirement where the students employ ArcGIS 10 to build scenarios in anticipation of what a change in management from the Valles Caldera National Preserve to the National Park Service do to change the functioning of the preserve. The students use a standard grading rubric for discussions based on quality and content, and a more specific rubric for the geodesign component that focuses on spatial thinking, creativity, and collaboration. Initial student reactions indicate that those selecting this assignment found it engaging and meaningful.

## INTRODUCTION

Geodesign education provides opportunities for enhancing creativity, encouraging collaboration, and stimulating critical thinking, especially critical spatial thinking. A hallmark of geodesign education is its reliance on real-world scenarios with tangible, often serious consequences (Tulloch 2013). This authenticity plays into the learning styles of today's millennial generation of learners who seek relevance from their learning (Healey et al. 2005). Essentially a form of project-based learning, geodesign education leverages realism and relevance to create an environment in which the learner can benefit from the multi-sensory inputs of a complex problem (Dede 2005) and a realistic setting via problem-based learning (Drennon 2005). I developed this extra credit exercise with those primary benefits in mind.

## APPROACH

I created the exercise as an extra-credit assignment for those students who either wished to excel or for those who felt they needed the extra points. While an extra credit assignment, it was thoroughly integrated with the rest of the course. At the beginning of the semester I require students to first form a learning community by introducing themselves via the discussion channel with our learning management system. This also introduces the students to the discussion tool and encourages them to engage in their own learning.

As the students build community they are also introduced to the Valles Caldera National Preserve, provided access to their design documents, and given their working geodatabase. These are used by all students for GIS-related discussion questions and for the final design project which involves enumerating existing and potential GIS data products that support the mission of the Valles Caldera National Preserve Trust, who currently manage the enormous multi-use facility. The questions are designed to scaffold the students knowledge about the caldera, its management, and the spatial components available in the GIS that can be leveraged to support its management (Figure 1).

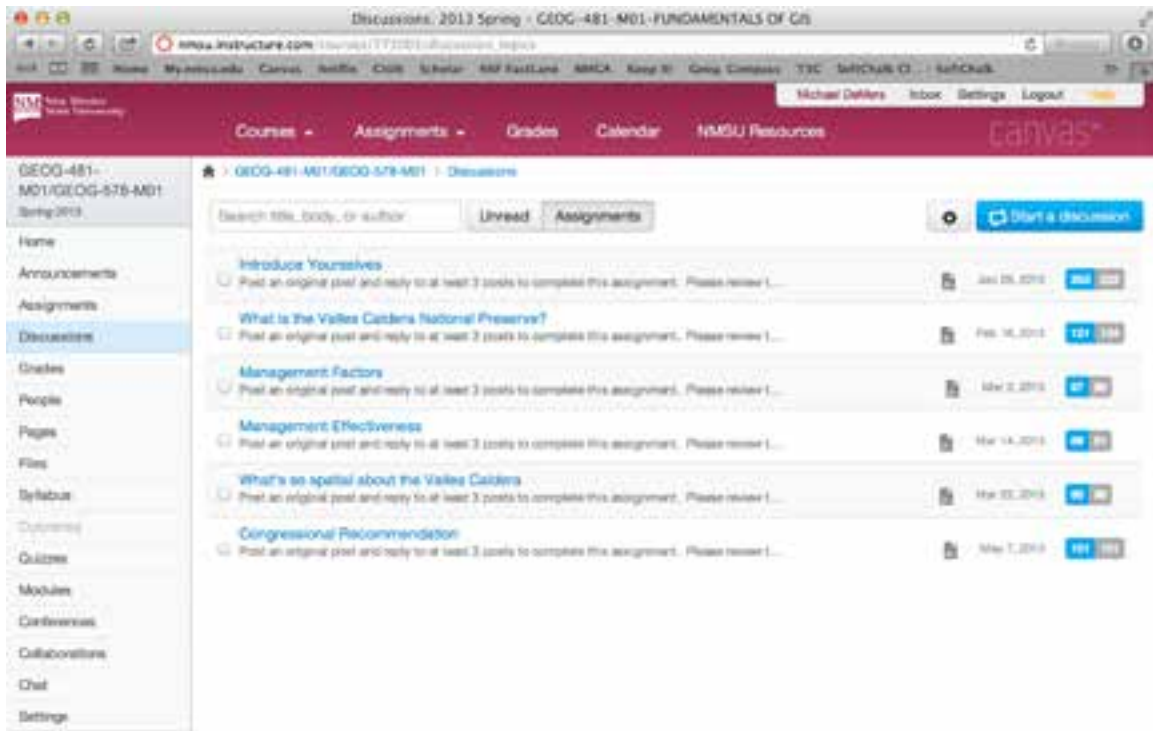


Figure 1. Discussion questions designed to prepare students for the geodesign project.

The extra credit exercise is driven by pending legislation introduced by US Senator Tom Udall (S.284) that impacts the management of the preserve. Called the Valles Caldera Preserve Management Act, the legislation proposes moving management of the Preserve to the National Park Service. The students are asked to use Valles Caldera geodatabase, the existing Valles Caldera design and management documents, ArcGIS 10 software, and ArcGIS sketch tools to do the following:

- Describe the existing environmental condition and functioning of the Preserve.
- Select at least two factors (e.g. roads, toilet facilities, recreation areas, etc.) that are likely to be impacted by a move to the National Park Service.
- Use the sketch tools to make the necessary changes to the GIS database
- Evaluate the impact of these changes using some simple GIS functions or other evaluation strategies (e.g. economic evaluations).
- Describe at least two iterations (two attempts) at each change and describe how you used these to arrive at a recommendation to congress.

All of these are aimed at informing congress about the potential viability of such a change in management. They are supported and evaluated by a rubric where each of the five tasks is evaluated individually on a 20 point scale (Figure 2).

GeoDesign Rubric

GeoDesign Rubric						
Criteria	Ratings					Pts
Situation Description	Thorough description of the current landscape situation. Includes evaluation of (A) the physical makeup (B) estimate of how it is operating. 20 pts	Adequate description of the current situation. Includes a basic evaluation of (A) the physical makeup and (B) an estimate of how it is operating. 15 pts	Adequate description of the current situation but either the (A) physical makeup or (B) an estimate of how it is operating is missing. 10 pts	Minimal description of the current situation. 5 pts	No submission 0 pts	20 pts
Factor Definition	Complete description of landscape alteration. Includes (A) factor and (B) rational reasoning behind why you chose this and why the change might happen. 20 pts	Adequate description of landscape alteration. Includes (A) factor and (B) adequate reasoning behind why you chose this and why the change might happen. 15 pts	Adequate description of landscape alteration. Includes either (A) factor or (B) adequate reasoning behind why you chose this and why the change might happen. 10 pts	Minimal description of the landscape alteration. 5 pts	No submission 0 pts	20 pts
Factor Implementation	High quality GIS implementation and description of well thought out analysis and modeling. 20 pts	Good quality GIS implementation and description of a reasonably well thought out analysis and modeling. 15 pts	Adequate quality GIS implementation and description of a modestly well thought out analysis and modeling. 10 pts	Minimal quality GIS implementation and description of a minimally thought out analysis and modeling. 5 pts	No submission 0 pts	20 pts
Factor Evaluation	High quality description of your evaluation of the impacts of your landscape change. 20 pts	Good quality description of your evaluation of the impacts of your landscape change. 15 pts	Adequate quality description of your evaluation of the impacts of your landscape change. 10 pts	Minimal description of your evaluation of the impacts of your landscape change. 5 pts	No submission 0 pts	20 pts
Iteration & Decision	At least two iterations and full description of your final decision and how you arrived at it. 20 pts	At least two iterations and adequate description of your final decision and how you arrived at it. 15 pts	At least one iteration and full description of your final decision and how you arrived at it. 10 pts	At least one iteration and minimal description of your final decision and how you arrived at it. 5 pts	No submission or no iterations. 0 pts	20 pts
Total Points: 100						

Figure 2. Geodesign rubric.

An examination of the rubric reveals its close association between the individual components of the exercise and the Steinitz Model of Landscape Change (Figure 3) (Steinitz 2012). The students are provided with this diagram so that they not only understand the relationships between the individual components of the exercise, but also how this fits into the larger geodesign literature (Jorgensen 2012). Because there are five steps involved in the project the students are given one week for each for a total of five weeks to complete the assignment. In addition, the assignment, all the preceding discussion questions, the geodatabase, and all supporting documentation are made available at the beginning of the semester, thus allowing the students plenty of time to begin working on the project.

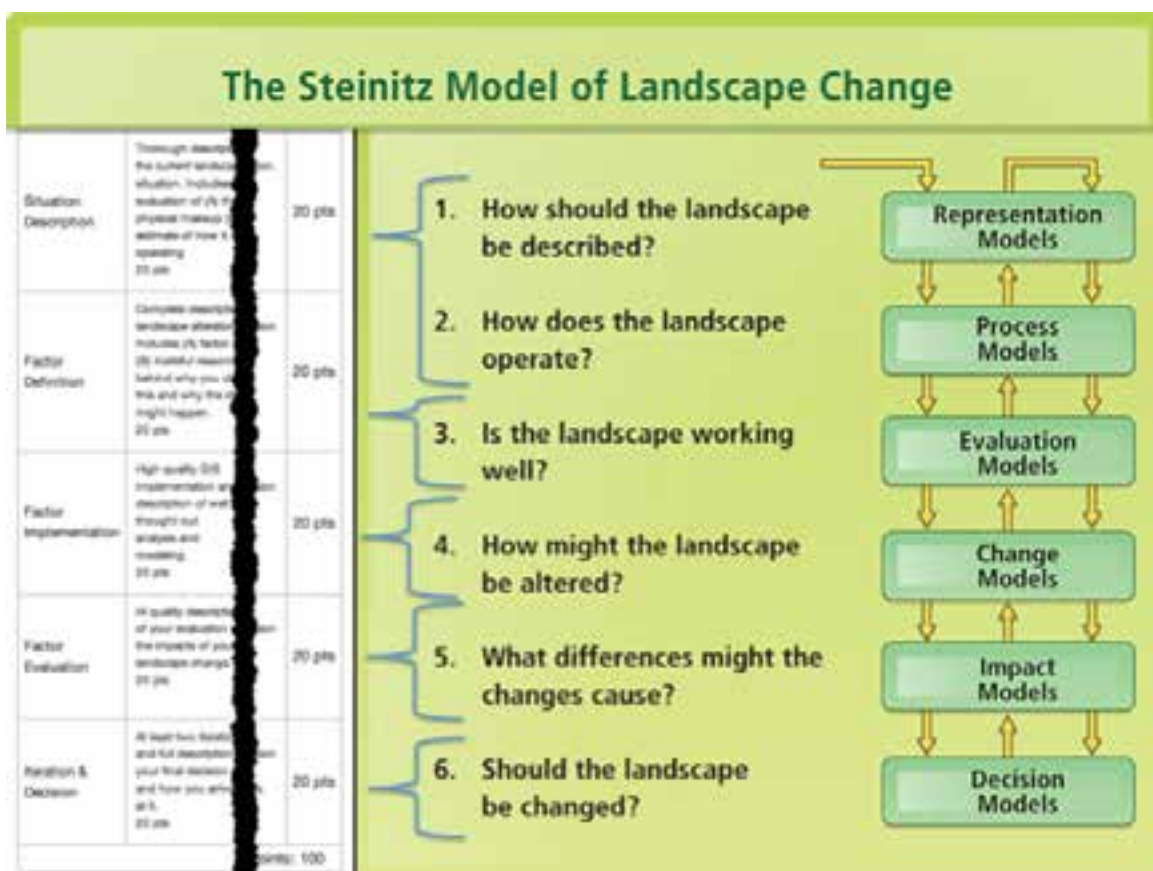


Figure 3. Relationship between the five assignment tasks (left) and the Steinitz Model of Landscape Change.

Each student was expected to present the results orally in an asynchronous, interactive format that allowed input both from the instructor and their fellow students. To do this I chose to use VoiceThread<sup>®</sup> because it allows for audio, visual, and text input and provides interactivity with students (Figure 4). Viewers can pause the presentation, ask questions using text, voice, or webcam (and even telephone if needed). VoiceThread<sup>®</sup> is also easy to use and requires a minimum

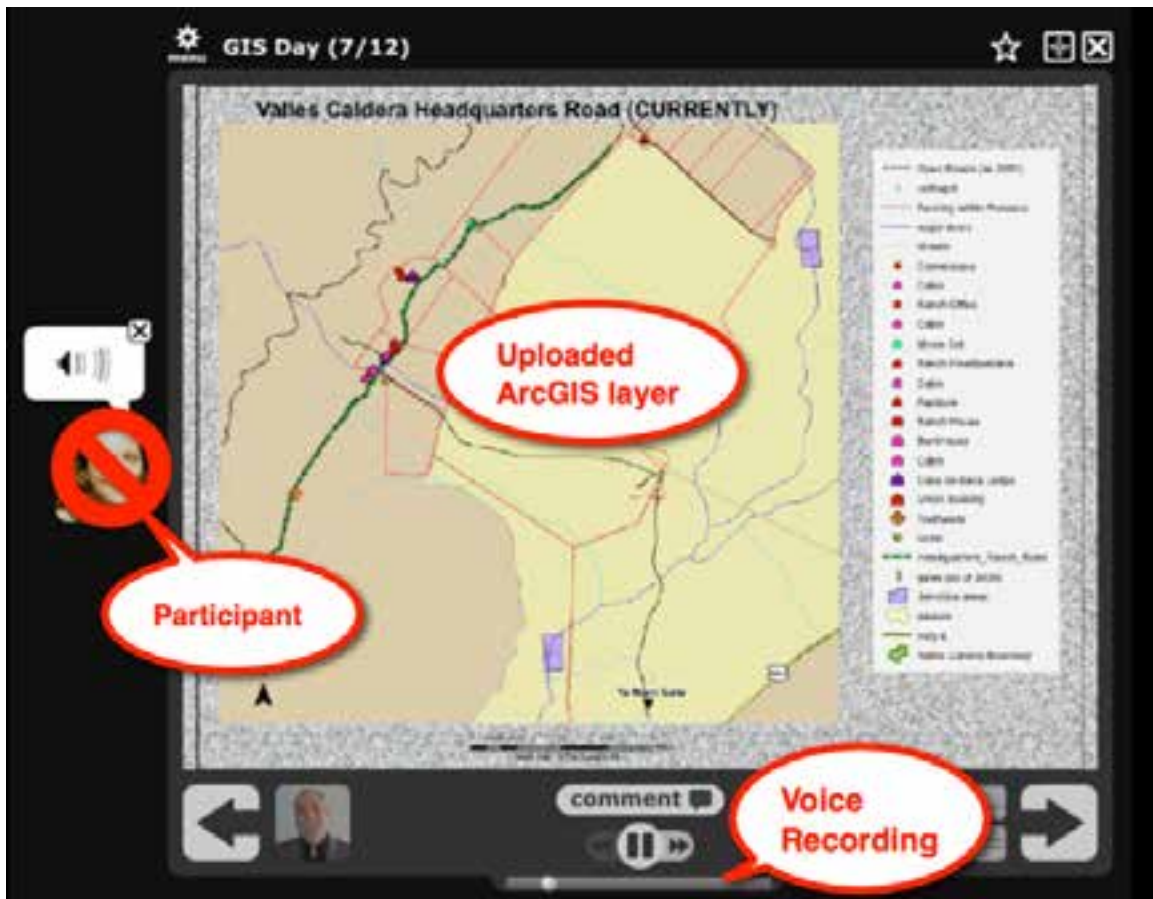


Figure 4. Typical student output using VoiceThread.

amount of technology to be successful. Students were required to upload relevant frames from their work and to discuss each of the five components using voice (if possible) as if they were presenting this in a formal presentation setting (e.g. 15 minutes or so).

## EXPERIENCES

I have introduced this in two classes so far, one in the Fall of 2012 and one in the Spring of 2013. I did not provide formal questionnaires, attempted no statistical analysis, or even pursued certification by the Institutional Review Board as this was a rapid prototype of what I hope will be a larger more focused study. Generally approximately 20% of each group took advantage of the opportunity for 100 points. Interestingly, the vast majority of those who did so were in the top 10% of the class so the results of these experiences may not be typical of all students.

## RESULTS

Five students finished the assignment in the Fall of 2012 and 9 finished it in the Spring of 2013. In virtually all cases the students described their experiences as “fun” and “enlightening.” They posted their work using the VoiceThread<sup>®</sup> tool and seemed engaged as interpreted by the enthusiasm I heard in their voices. Two students told me that they spent many hours on the work because it was so interesting. Another told me that it was the most useful part of the course. All of the assignments received high marks in all aspects of the work although the final step seems to have escaped some of them. This part of the exercise did not seem to be well described in the exercise description and there seems to have been some confusion about exactly what was meant by iterate and describe.

Most, but not all, students actually made a recommendation to congress based on their work. In informal conversations with some students, they indicated that they felt uncomfortable making a recommendation to congress based on only two or three impacted factors. Others felt inadequate in their understanding of the Caldera and of their ability to use the GIS software for such work.

Generally all the students seemed satisfied with the assignment and I received no negative comments regarding its content, the approach, or the amount of work. Most seems uncomfortable with VoiceThread<sup>®</sup> at first but adapted to it readily once they figure it's simple user interface out. One student suggested the use of VoiceThread<sup>®</sup> in other earlier work so that they don't have to learn the user interface while the project is going on. All of the students I talked to said that I should continue the assignment but with more explicit instructions, a bit more demonstrations, and previous experience with the tools.

## CONCLUSIONS

The overall experience seems to be a success based on informal reactions from the students and the quality of the output. I see a need to spend more time on the development of an ecological understanding of the Valles Caldera and it might be useful to review some approaches to geodesign using ArcGIS during the exercise so that the students can see how it is done. It might also be useful to break the project up so that each of the five parts is a separate, but related exercise. The students tended to procrastinate, thus pushing all the work to the very end. This may also have contributed to the lack of emphasis on part five of the exercise.

Whether the assignment should be given as a regular exercise rather than as extra credit remains to be seen. Because most of the students engaged in this work were in the top 10% of the class based on grades, there is some concern that other students might not be as engaged in a project requiring integration and interpretation. As an experiment it might be worth trying.

It is difficult to make any solid conclusions about the learning outcomes from this experience, as there were no hard data collected. The purpose of the first two implementations was to determine if the assignment was viable and engaging. That seems to have been proven. A more systematic approach will be needed in the next

iterations of the work and hard data need to be collected. Focus on whether higher levels of Bloom's taxonomy is being achieved from the exercise, and on whether or not critical spatial thinking is enhanced will require the development of mixed-methods to examine formal questionnaires and open-ended questions and interviews. This work does seem to set the stage for such an analysis upon some modifications.

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