Geodesign as an Educational Tool: A Case Study in South Cache Valley

Barty Warren-Kretzschmar[1], Carlos Lincon[2], Hrishikesh Ballal[3]

[1]Utah State University, Utah/USA · barty.warren@usu.edu
[2]Utah State University, Utah/USA · carlos.licon@usu.edu
[3]Centre for Advanced Spatial Analysis, University College London, UK

Abstract: Past Geodesign case studies show that the software Geodesign successfully supports interdisciplinary groups of experts, planners and university students in developing scenarios for future change. This paper focuses on the educational aspects of using Geodesign in the studio setting with both planning and design students. In the South Cache Valley, Utah case study the experience of participants in a Geodesign workshop was evaluated. In addition, landscape architecture and bioregional planning graduate students assessed the benefits and difficulties they experienced in an eight week Geodesign studio and workshop. These findings inform recommendations for developing a Geodesign learning module for secondary education.

Keywords: Geodesign, education, landscape planning, design

1 Introduction

The environment decisions that communities make today will leave a lasting imprint on the landscape of the future. Increasingly, particularly in light of climate change, communities undertake visioning processes in an attempt to develop sustainable future visions for their community (BRUENING et al. 2014). This development has been accompanied by digital tools that help participants understand local issues and articulate options for the future (KWARTLER & LONGO 2008). The visioning process attempts to describe a desired outcome or alternative future for a 20 to 40 year time frame. Visioning encourages citizen participation in setting goals for the future of a community and incorporates the normative values of the participants (SHIPLEY 2002). But how old are the citizens and stakeholders who create scenarios for future visions? If these participants are over thirty, chances are they will be observers of the vision when it plays out in forty years. If visions for our future communities are to meet the needs of the people who are actively living them, then we must involve young people in the process.

But can teenagers and college students sufficiently understand the complexity of the issues and the consequences of environmental decisions on the future community and landscape? How can we empower young people to open their imaginations to shape the future of their communities? Geodesign offers a collaborative, iterative process to propose change, which can be rapidly assessed during the planning discussion (STEINITZ 2012). Past case studies of the use of the Geodesign software show that it successfully supports interdisciplinary groups of experts, planners and university students in developing scenarios for future change, as well as negotiation and decision-making among the participants (RIVERO et al. 2015). But can Geodesign be used to teach young people who are not planning students or professionals about complex environmental issues and collaborative decision making?

In order to address these questions, landscape architecture (MLA) and bioregional planning (MsBRP) graduate students were taught the Geodesign process in an eight week Geodesign

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studio which culminated a one day workshop with Prof. Carl Steinitz and Dr. Hrishi Ballal using the Geodesign software (Geodesignhub.com). The resulting Geodesign project forms the basis for developing a learning module for secondary education. This paper discusses the experience of using Geodesign to teach both design and planning students, the lessons learned from the workshop preparation, as well as the experience in the Geodesign workshop. Also of interest is the capacity of Geodesgin to bridge design and planning approaches and scales in the teaching environment (WARREN-KRETZSCHMAR et al. 2012). Finally, the experience gathered in this investigation provides the background for adapting a Geodesign project to the secondary educational setting.

2 Methodology

During an eight week period nine MLA and MsBRP students participated in a joint Geodesign studio in which they assessed the study area and developed evaluation models for ten systems that are central to the development of South Cache Valley. A one day Geodesign workshop ensued that was led by Carl Steinitz and supported by Hrishi Ballal via skype. The 28 workshop participants, which included local stakeholders, planners, faculty and students, were asked to complete pre- and post-workshop surveys. The objective of the pre-workshop surveys was to validate the selection of systems and issues, and the post-workshop survey assessed the usability of the software, workshop satisfaction and areas of improvement. A qualitative content analysis was used to evaluate the survey comments and identify recurring themes in the responses.

After the workshop, the MsBRP students completed the negotiation between stakeholder groups and developed the implementation timeline for their final proposal in the studio setting. The student experience was evaluated with online surveys that addressed the usability of Geodesign software, workshop preparation, and the learning experience. In addition, the students submitted assessment essays of their experience. The results of the surveys and discussions with the graduate students, as well as participant observation by the faculty provided the background for developing a Geodesign learning module for secondary education (grades 9-12).

2.1 Student Participants

Four MLA students in their fifth semester and five, first-semester MsBRP students participated in the Geodesign studio that was taught by professors from both programs. Both groups had little or no experience with GIS software or landscape analysis. It should be noted that the different degree programs address quite different scales and issues. The focus of the MSBRP program is on the analysis and planning of natural and human systems at the watershed scale, while the MLA program emphasized site and community scale design (see Figure 1).

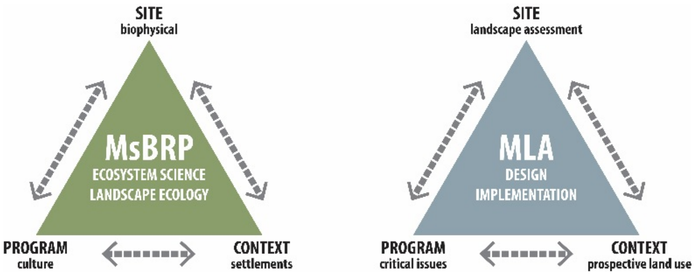

Fig. 1: The areas of emphasis of the Master of Science in Bioregional and the Master of Landscape Architecture programs

2.2 Workshop Preparation

At the beginning of the semester, graduate students met with stakeholders and local planners, made site visits and flew over the study area. The students were required to submit project opinion papers identifying the scope of the project and important issues, as well as research and analyse of the natural and cultural systems of the project area. Based on their analysis of the issues and discussions with local experts, ten systems were chosen that were deemed important. These included: 1.) Water, 2.) Biodiversity, 3.) Public health and safety, 4.) Landscape character, 5.) Agricultural land, 6.) Residential development, 7.) Commercial /Institutional, 8.) Recreation, 9.) Transportation, 10.) Renewable energy (see Figure 2).

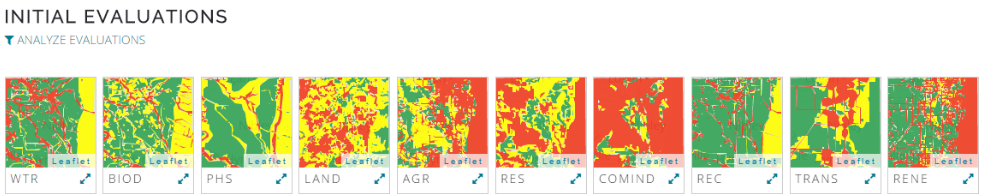

Fig. 2: Evaluation models for ten systems, red indicates areas where change should not occur and shows where change may occur

With assistance from a GIS expert, each graduate student prepared one evaluation model following the process described by RIVERO et al. (2015). Initially the maps were identified as "attractiveness" and "vulnerability" maps with three levels shown in red, yellow and green. However, prior to the workshop the evaluation models were adjusted to show areas where "change" can occur in green and areas where "no change" should occur in red, and intermediate areas in yellow. The students documented the evaluation maps with conceptual diagrams of the evaluation models and posters of the models were hung in the workshop. In addition, each student assessed the impacts of the other systems on their evaluation model, two students researched the implementation costs and this information was made available in the Geodesign software.

2.3 Workshop Participants

The workshop included a range of experts, local stakeholders, and faculty with background pertaining to at least one of the ten systems. Representatives from the farming community, wildlife organizations, federal and state agencies, as well as the county transportation planner and planners from the local, regional and county agencies were among the participants. Also faculty from watershed science, landscape architecture and remote sensing participated in the workshop. Finally, an environmental education teacher was invited to participate and provide feedback.

3 Case Study: South Cache Valley

3.1 Study Area and Issues

Cache Valley is a rural, agrarian landscape that is surrounded by the dramatic Wellsville and Bear River mountain ranges. The valley was originally settled by Mormons pioneer who developed extensive canal system for irrigation, transforming the arid landscape into a rich, agricultural landscape. The Mormon settlers also laid out towns in a grid system known as the Platt of Zion. Today the historical town centres throughout the valley are experiencing rapid and poorly controlled growth. The conversion of farmland into subdivisions and commercial growth as strip development threatens the rural identity of the valley.

Fig. 3: Overview of the study area (marked in red) and view of Hyrum city and reservoir in south Cache Valley bordered by the Bear River range

Presently, the population of Cache Valley is approximately 130,000 people, with 50% of the population under 25 years of age (US CENSUS 2014). The growth of the population, which is expected to double in the next 25 to 30 years, challenges the preservation of the rural character of Cache Valley and the recreational and natural resources of the surrounding mountains. Surveys of Utah residents show that the top concerns are: loss of agricultural land, water availability, and air pollution (ENVISION UTAH 2015). Residents would like to retain viable agricultural land and preserve the rural character. Climate change and drought in the western landscape make water a scarce and controversial resource. Furthermore, the topography of the valley is prone to inversion conditions, which often produce dangerous air quality during winter inversions. In the face of doubling population, planners and politicians must find ways to guide development into the future that address these and other issues in Cache Valley. The south half of Cache Valley was chosen as the study area because it is expected to experience the most pressure of urban expansion over the next 20 years (see Figure 3).

2.4 Workshop

The workshop started with an introduction by Carl Steinitz to Geodesign and the Geodesign software. (All participants had received a link to the Geodesignhub.com software tutorial prior to the workshop.) Participants were divided into ten system teams of three people, which were led by the students who had developed the evaluation model for the systems. The teams worked until lunch developing projects and policies to improve their individual systems (see Figure 3).

In the afternoon, the participants formed six stakeholder groups with graduate student leading the teams. The stakeholder groups included: farmers, developers, young people, older people, environmentalists and regional planners. The teams were given a program of change that was driven by a doubling of the population by 2040. Each group was asked to: double housing and commercial space in South Cache Valley; preserve agricultural land; protect water quality and quantity, provide public or multi-modal transportation to all municipalities in South Cache Valley; provide 1000 acres of solar panels; and preserve wildlife habitat in the Valley as well as improved access to outdoor recreation.

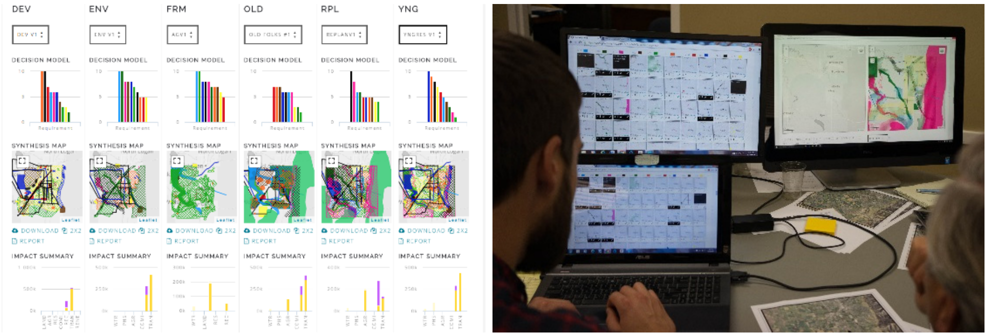

Fig. 4: Proposals for South Cache Valley that were developed by the stakeholder groups. Workshop participants developing proposals (Photo by C. McGinty).

Each team set the priorities of their systems according to their interests, and developed several iterations of proposals for the future of south Cache Valley using the projects and proposals that were created for the ten systems. By the end of the afternoon, the teams presented

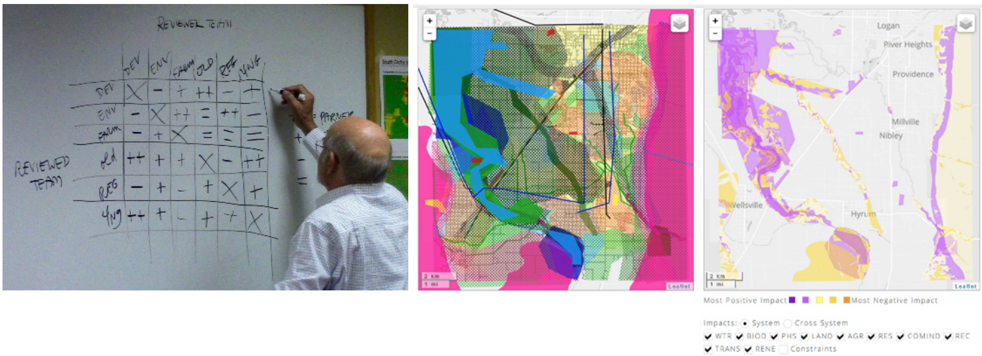

Fig. 5: Sociogram of stakeholder teams, the final design, and the related system impacts of the projects that show where projects benefit their systems (purple = positive impacts, orange = negative impacts)

their preferred proposal to the other groups (see Figure 4). In a sociogram, the groups identified which stakeholder groups they could partner with (see Figure 5). At this point the workshop ended. Time did not permit negotiation during the workshop, however, the MsBRP students completed the stakeholder negotiation after the workshop according to the relationships established in the sociogram. Interestingly, most teams wanted to negotiate with the older people, while the farmers were the least popular. The MsBRP graduate students negotiated the six designs down to one final proposal after the workshop.

3 Results

3.1 Workshop Reviews

A one day workshop is hardly long enough to address all the issues in the study area. Unsurprisingly, the time constraint was the primary criticism of the workshop. As one planner described it, "The workshop was like drinking from a firehose, but every drop I caught was worth it." The content analysis of the comments from the post-workshop survey showed that the collaborative nature of the software, i. e. teamwork, and the ability to compare alternatives, played an important role in understanding the opportunities and constraints in the study area (see Figure 6). Repeatedly, the workshop participants identified the software as intuitive and the team work as productive.

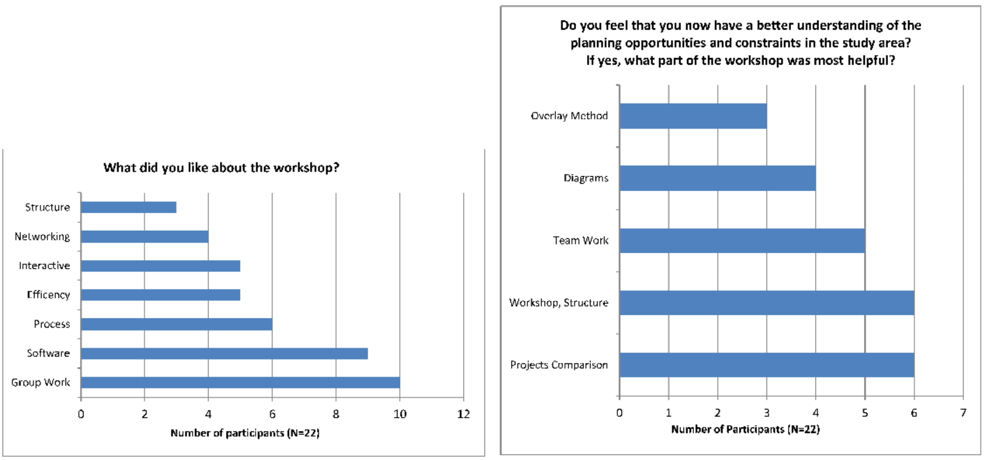

Fig. 6: Content analysis of the comments made on the post-workshop survey

3.2 Student Assessment of the Geodesign Teaching Module

The (MsBRP) planning and (MLA) design students evaluated their experience in the Geodesign studio differently, which may be due to a myriad of factors, e. g. course load, expectations, previous experience, that are difficult to specify. However, both groups agreed that combining MLA and MsBRP students in the Geodesign studio gave them exposure to different analysis and design approaches as well as different scales of work. The students also remarked that the Geodesign workshop helped them understand the perspectives of different stakeholders, and they benefited from the opportunity to work collaboratively with experts and professionals. Student dissatisfaction with the Geodesign teaching module, on the other hand, focused on time constraints and the teaching context rather than on the Geodesign software or workshop.

Challenges: Time, GIS skills and Terminology

Most of the students found the eight week time frame to investigate the study area, identify issues, and prepare the evaluation models to be very rushed. The studio project was their first exposure to landscape analysis and the Geodesign process, which required students to acquire and apply new theory and knowledge to understand the site and develop evaluation. The fast pace and demands of the course required a considerable time commitment, which many MLA students could not make due to heavy course loads, causing much anxiety. On the other hand, the MsBRP student course evaluations indicated that they considered the Geodesign module to be a valuable and relevant learning experience, despite the time constraints. The eight weeks gave them a "quick and dirty" overview of the planning process and an understanding of how to approach planning issues.

The fact that most of the graduate students had no or only rudimentary GIS skills increased the challenge of preparing the evaluation models in eight weeks. While some students struggled with the GIS software, others found it an opportunity to become proficient with the software. However, assistance from a GIS expert in this phase was essential to the success of the models. As a whole, the MLA students had little experience with landscape level work and they found the preparation of the evaluation models to be confusing and frustrating. Whereas the planning students found developing the evaluation models helped understand the criteria for landscape assessment. One MsBRP student responded that the preparation of the evaluation models was "difficult with the level of GIS experience, [but] very helpful and insightful to have accomplished them."

Terminology was a source of confusion throughout the studio. The language used to describe the different types of models differed between the MLA and MsBRP students. For example, MLA students used vulnerability model to describe what the MsBRP students called an environmental assessment model. (For these models, the students agreed that areas in need of protection are typically shown in red.) Similarly, what MLA students call suitability models, MsBRP students named land use allocation models. (Areas that are attractive for particular land uses were represented in green.) In Geodesign, the evaluation models encompassed both attractiveness and vulnerably models. Furthermore, the evaluation models identify areas for "change" (green) and "no change" (red), which at first, was a difficult concept for the students to accept.

The benefits are in the workshop

Although the students found building the evaluation models prior to the workshop to be difficult and rushed, they clearly understood the Geodesign process and outcomes in the final workshop. Most of the MLA and MsBRP students considered the development of projects and policies with the Geodesign software to be intuitive and straight forward. It offered them the opportunity to apply their knowledge about the study area in a collaborative situation with professionals.

In the following phase of developing proposals in stakeholder groups, the students reported that the software supported a collaborative discussion about potential proposals and broadened their perspective as well as the stakeholder's perspective of future development in the study area. For one student, this was an aha moment, when "the Geodesign process suddenly all made sense."

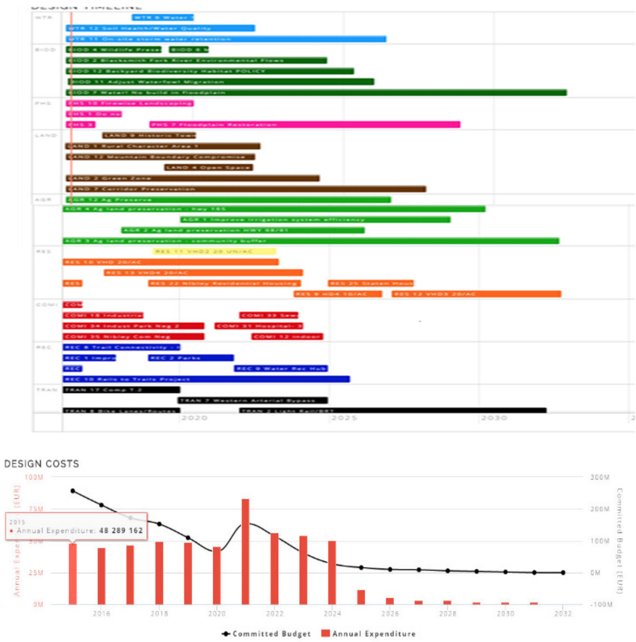

Fig. 7: Implementation time line and design costs for the final proposal

Because the workshop was limited to one day, the negotiation between stakeholder groups took place after the workshop among MsBRP student who represented each of the groups. The different ability to compare the different layers/systems of each proposal set the stage for negotiated agreement on the final proposal. Although the students would have preferred to have real stakeholders involved in the negotiation, they considered the role playing a constructive exercise that provided insight into the motivation and demands of the different stakeholder. For the negotiated final proposal, the students used the Geodesign implementation timeline to debate the duration and sequence of proposed projects and policies (see Figure 7). The ability to see the effects of the implementation sequence and duration on the overall costs was central to the discussion and drove home the complexity and consequences of their planning proposal.

4 Discussion

Due to the small sample of students, the intent of this study is exploratory in nature. The teaching experiment of combining planning and design students in a Geodesign studio introduces factors on many levels that influenced the students' assessment of the teaching module. That said, some interesting observations can be made about Geodesign as a teaching module in relation to the different groups of students, i. e. the different curriculums, which may have consequences for using Geodesign in secondary education

Collaboration between design and planning students

During the Geodesign studio, it was observed that the MLA students gravitated to working with the human systems, while the MsBRP students chose to work on the evaluation models of the natural systems. This may reflect the focus of the different curriculums, but the joint studio also held the potential to expand the perspective of both groups. Unfortunately, the time constraints and the location of separate studio spaces curtailed the opportunity for collaboration. Thus, the students worked within their own group and the cross pollination of skills, knowledge and ideas between groups was limited. Never-the-less, the MLA students profited from the MsBRP students' understanding of the influence of the environmental systems on the site and context. The MsBRP students, on the other hand, profited from the exposure to the process oriented thinking and graphic presentation skills of the designers. Ultimately, the MsBRP students considered the module more relevant to their education than the MLA students. Once again, this may reflect in the focus of the MLA curriculum on site scale design.

High school students do not have the background of design and planning students. The challenge will lie in teaching sufficient theory and knowledge for them to understand the Geodesign process in a limited amount of time. Starting with the existing evaluation models of the South Cache Valley Geodesign project, students must first understand how the systems function. The graduate students, who have developed the models, will function as "system team leaders", who teach the theory and knowledge behind their models to the high school students. In addition, we plan to reduce and balance the number of human and natural systems that are used in the classroom, as well as simplify the proposed change to the landscape.

The challenge of evaluation models and terminology

Developing the evaluation models presented the students with the most challenge. The conceptual basis for developing landscape evaluation models was new, and they need more time to acquire background knowledge, identify issues, research the structure and function of the site, and develop an understanding of the evaluation models. Possibly, expanding the Geodesign module to a whole semester would have alleviated many of the problems, by allowing the students more time to acquire the necessary knowledge and GIS skills. On the other hand, the half semester module forced students to move through the planning process quickly, which felt frustrating during the process. However in the end, the students had a good understanding of the Geodesign process. They then had the second half of the semester to explore the final proposal in more depth or examine the watershed context of the study area.

Finally, terminology and symbology were stumbling blocks for some students. Because the students and workshop participants were accustomed to thinking in terms of "attractiveness" and "vulnerability" models, they had difficulty to rethink the evaluation models in terms of "change" (green) and "no change" (red). However, the concept of change / no change in the landscape may actually be an easier concept to communicate to high school students than attractiveness and vulnerability of systems.

5 Conclusion and Future Research

The primary hurdle in teaching the Geodesign module with the Geodesign software was the preparation of the evaluation models with students who had rudimentary GIS skills and little previous experience in landscape analysis. For this audience, either more time or a more concentrated teaching opportunity would helpto impart the theory, knowledge and language behind a Geodesign project. However, once that task was accomplished, the students had little difficulty using the Geodesign software, and in workshop they engaged in collaborative planning decisions. The students used the technology in teams, reminiscent of teams designing on a base map with tracing paper. Furthermore, the Geodesign software offered several capabilities that supported teaching in innovative ways. For example, using the software to negotiate a final proposal helped the students understand how stakeholders' different objectives can affect the outcome of the final plan. In addition, the ability to develop a long term implementation plan, while viewing the related costs, would be difficult at best without the software. This cost feedback loop offered invaluable insight into the reality of the students' proposed design.

Experience gathered in this study provides important background for developing a Geodesign teaching module for secondary education. Time constraints, curriculum and the students' understanding of landscape analysis will define what can be accomplished in the school setting. The complexity of the planning issues will need to be reduced by simplifying the change model and focusing on fewer systems that are central to understanding the effects of change. Undoubtedly, the secondary students will quickly understand the software. The challenge will be to use the software to teach the theory and knowledge behind planning decisions within the constraints of the high school curriculum.

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